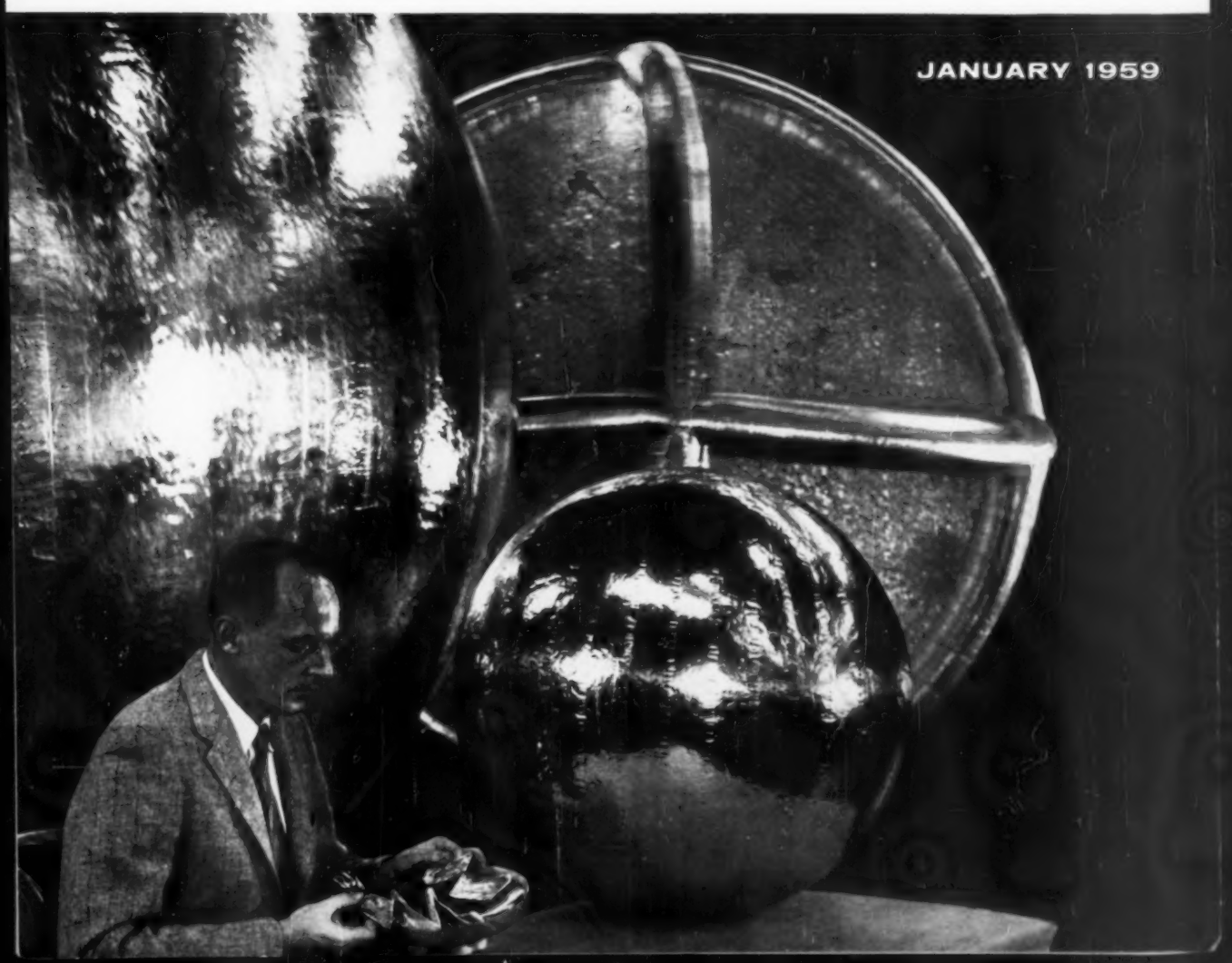
PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

The Outlook for 1959 ..... page 23

Nuclear Energy in Polymerization ..... page 29

Metallized Mylar Balloons ..... page 52



JANUARY 1959

At Canadian General Electric Company, Limited:

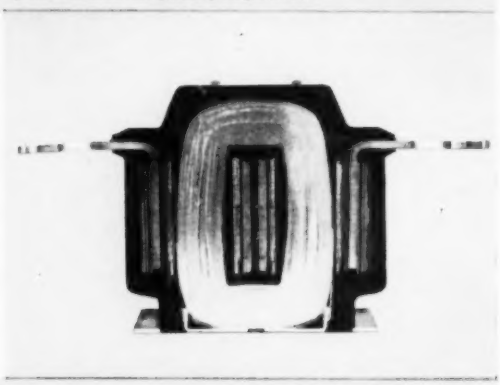
OLD

Previous, asphalt-impregnated transformers, made by Canadian General Electric, Limited. Insulation strength was limited.

NEW

Streamlined transformers, molded with Epon resins, have superior insulation, dielectric strength; accuracy, performance are greatly improved.

Following curing period, the mold is quickly unbolted and the Epon resin-potted transformer removed.



Cutaway view of new instrument transformer clearly shows the complete penetration of Epon resins.

Epon® Resins improve performance, streamline appearance of instrument transformers

When Canadian General Electric Company, Limited, Toronto, Canada, decided to produce a new line of instrument transformers, they were faced with several critical problems: how to ensure performance, reliability, and appearance . . . all on a mass-production basis.

They solved all their problems with Epon resins.

Result: these handsome new transformers, completely impregnated with Epon resins, have high insulation and dielectric strength, good impact resistance, excellent heat dissipation, and increased ability to withstand creepage. Cracking and oxidation are virtually eliminated.

If potting, laminating, sealing or encapsulation play an important role in your operations, be sure to investigate Epon resins. They may be able to solve a production problem for you. For assistance and technical information, write to your nearest Shell Chemical office listed below.

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Please send changes of address to the New York office.

It's high time... to plan with *Catalin* STYRENE

However satisfying Christmas 1958 was for you—and we hope it brought you a wealth of good things—it is *already* time for you to start planning your new packaging and product ideas for Christmas 1959 . . . so that mold-making, production and marketing operations can be coordinated well in advance, to arrive at the holiday market with the utmost in customer-appeal.

In an industry long recognized for its packaging excellence, Trim-a-Tree®—shown above, molded of general-purpose CATALIN STYRENE, represents an entirely new concept in watch packaging. Designed by Bulova to pinpoint and enlarge its sales potential during the important Christmas season, it ingeniously fulfilled every requirement of its responsibilities . . . as a custodian of Bulova's prestige and quality . . . as a point-of-sale display . . . as a handsome gift package . . . and as a decorative tree ornament.

For the most effective packaging of your own product in 1959, weigh well the unsurpassed qualities offered you by CATALIN STYRENE, in general-purpose, impact or heat-resistant grades . . . by CATALIN POLYETHYLENE, in the widest range of densities and melt indexes . . . and by CATALIN NYLON, in extrusion, injection or blow molding grades. Inquiries invited.

®Trim-a-Tree was designed by Bulova Watch Co., developed and produced by Shield, Inc., New York, N. Y.

Catalin Corporation of America **One Park Avenue, New York 16, N. Y.**

PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

JANUARY 1959 VOLUME V NUMBER 1

FEATURE ARTICLES:

THE OUTLOOK FOR 1959 p.23

In a series of specially written statements by industrial leaders, the plastics industry views and predicts its prospects for 1959.

APPLICATION OF NUCLEAR ENERGY TO THE POLYMER FIELD p.29

By Dr. Daniel Greenberg

A comprehensive review of the mechanics of radiation and their application in polymerization reactions for resins. The quantity and varieties of radiation-cured polymers and radiation-produced grafts for special purposes are expected to increase rapidly in the near future.

DEVELOPMENT OF STEAM-RESISTANT FIBERGLASS-REINFORCED PLASTICS p.33

By E. G. Bobalek, W. M. Ellslager and Thomas Harris

Report on a test program emphasizing the need for hydrolysis-resistant polyesters, exclusion of water from materials, synthetic fiber overlays, cure operations, and the quality of premix compound products. These products can compete with many injection-molded thermoplastic parts with regard to strength, and be almost competitive in surface finish.

EXTRUSION THEORY—PART II p.39

By Dr. H. M. Hulburt, Dr. Stanley Katz and L. F. Street

The conclusion of a two-part article showing that a sound theoretical understanding of extruder operation can be of value in obtaining optimum results in actual performance.

ADVANCES IN THE TECHNOLOGY OF PLASTICS

DEVELOPMENTS DURING 1958 IN PROCESSING OF PLASTICS MATERIALS p.45

By R. R. Moyer

ENGINEERING FORUMS:

REINFORCED PLASTICS p.49

By Harry T. Douglas

Fiberglass advantages in the small boat field.

MOLDMAKING & TOOLING p.50

By Ernest J. Csaszar

What's new in mold making.

COMPRESSION & TRANSFER MOLDING p.51

By Paul E. Fina

A Veteran molder speaks on shrinkage control.

EXPLORING FABRICATION TECHNIQUES

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By L. J. Zukor

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Cover photo courtesy: National Aeronautics & Space Administration. Examining the spheres is Wm. J. O'Sullivan, Jr., head of the Space Vehicle Group, at Langley Field, Va.

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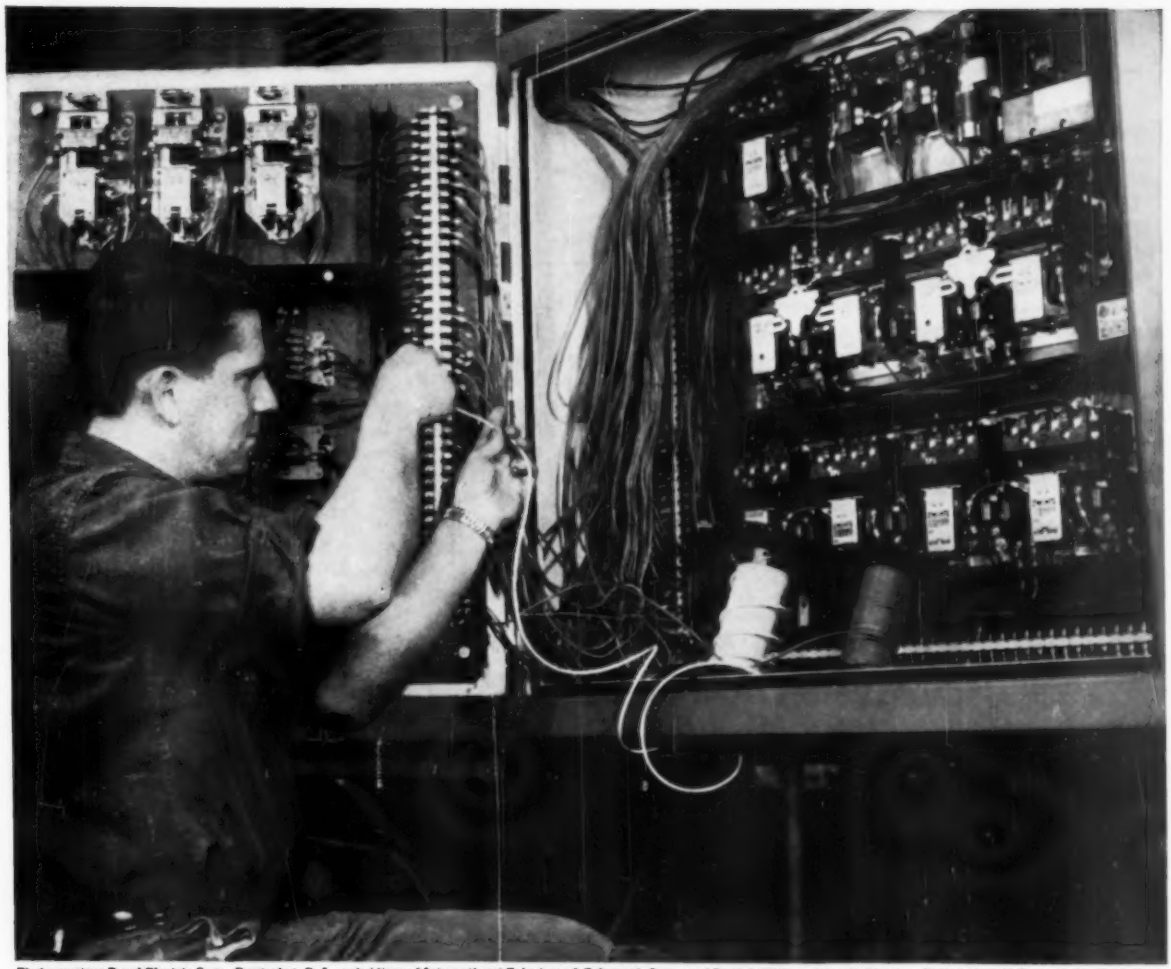

Photo courtesy Royal Electric Corp., Pawtucket, R. I., subsidiary of International Telephone & Telegraph Corp., and Pratt & Whitney Aircraft Division, United Aircraft Corp., E. Hartford, Conn.

How to keep an impulse on the right track

Ever wonder how an electrician keeps the many actuating impulses for an automatic machine tool, or similarly complicated equipment, on the right track? His secret lies in the brightly hued jackets for the many wires involved. By following a simple color code, he swiftly and surely solves any circuit.

Not so simple, however, was finding the right kind of colored covering for machine tool wire. It had to be thin, tough, highly insulative, resistant to oil, fumes and age—plus being available in a wide range of bright, permanent colors. A vinyl compound seemed logical, but not all vinyl resins could meet the tight specifications.

After much testing, a leading wire manufacturer finally chose PLIOVIC EDB90V—a dry-blending, electrical-grade vinyl resin—plus other materials for the job. The reasons: 1. Uniform particle size 2. Minimum dusting 3. Compatibility 4. Smooth extrusion 5. Superior insulation resistance and dielectric strength 6. Excellent physical properties.

If you have a need for a high-quality electrical grade vinyl resin, why not learn more about PLIOVIC EDB90V? Find out also about the other members of the PLIOVIC family. You can just by writing for details plus the latest *Tech Book Bulletins* to: Goodyear, Chemical Division, Dept. A-9441, Akron 16, Ohio.

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High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries

Previews of Next Month

The February issue will feature the following articles:

What a Plastics Engineer Should Look For When Planning to Buy a Compression or Transfer Press. F. J. Donohue, Tech. Service Specialist, Plastics Division, Monsanto Chemical Co., Springfield, Mass.

Proper planning includes due consideration of production requirements and such specific features as press capacity and type, heating method, controls, and auxiliary equipment.

•

PT's Comparative Data on Compression and Transfer Molding Machines.

This third installment of our special feature series on plastics processing machinery gives a lengthy, staff-written tabulation of comparative specification data on machines available from domestic manufacturers.

•

Environmental Stress-Cracking Resistance of High-Density Polyethylene. F. H. McTigue, Research Chemist, Hercules Powder Co., Wilmington, Del.

High molecular-weight resins, proper molding, and incorporation of elastomers in the plastic formulation are shown to provide increased resistance to environmental stress-cracking when applications are exposed to certain media.

•

Making Trailer Bathtubs of Reinforced Polyester With Urethane Foam Bases. D. M. Ware, Manager, Plastics Division, Sani-Glas, Inc., Amsterdam, N. Y.

Vibration-free bathtubs, suitable for use in trailers and permanent homes, offer lower manufacturing costs than conventional tubs, are installed easily, and are light in weight, chip-proof, resistant to household solvents and cleaners, and are easy to maintain.

•

Resin Characteristics Relating to Laminate Behavior. F. J. McGarry, Asst. Prof. of Matls. and Director of Plastics Research Laboratory, Massachusetts Institute of Technology, Cambridge, Mass.

The mechanical properties of fiberglass-reinforced laminates are influenced by such resin properties as glass/-resin joint strength, resin modulus, cohesive strength, ductility, coefficient of thermal expansion, cure shrinkage, and by glass fabric construction, ply orientation, and external loading conditions.

Letters to the Editor

Cast Polyethylene Film

Dear Mr. Zukor:

Your informative article on Cast Polyethylene Film Production which appeared in the September issue would be of considerably greater value to us if you could give us the linear velocity of film production by this method. By this we refer not to a theoretical maximum but to a production rate consistent with commercial quality.

F. E. Wiley
DeBell & Richardson, Inc.
Hazardville, Conn.

(In his reply, Lee Zukor stated that the consensus of opinion by all cast-film manufacturers is that the velocity of take-off is based only on the speed of the extruder, and that rates of over 300 feet per minute are average.—Editor)

• • •

Complete Address for Kautex

Dear Sir:

In your November 1958 issue, pg. 1028, in "Exploring Fabrication Techniques," you mention a blow molding machine incorporating an integral extruder being offered by Kautex U. S. Sales Corp.

Would you be kind enough to forward us the address of this company?

H. L. Schafer
Columbus Plastic Products, Inc.
Columbus, Ohio

(We print this letter as an example of the many similar requests received here for the complete address of Kautex—U.S. Sales Corporation, which is 38-01 23rd Ave., Long Island City 5, New York. Judging from the reader response to date, printing the complete address for Kautex in this "Letter to the Editor" will permit our editorial staff to spend their work-time on other matters than answering similar requests for the complete Kautex address.—Editor)

• • •

Information Wanted

Dear Sir:

I wish to determine whether plastic material is available in hollow round or hollow oval form in two small sizes so that one may be inserted tightly in the other, thus providing an extension rod.

Robert W. Clarke
Salt Lake City, Utah

•

Dear Sir:

Our company is having difficulty in locating firms that manufacture equipment for the dispensing of two-part epoxy resin materials. We would appreciate it very much if you could supply us with a list of manufacturers making this type of equipment.

Thank you for your consideration of our problem.

C. W. Carmichael, Prod. Engr.
Capacitor Division
P. R. Mallory & Co., Inc.
Indianapolis, Ind.

•

Dear Sir:

I am enquiring about plastic tile tools. I am in need of a tool called a "hot foot" to cut holes in plastic wall tiles to fit around water pipes in bathrooms, etc., also a plastic tile cutter. I have tried to find these here but without success.

Any help you can offer will be deeply appreciated.

C. R. Anderson, Owner
C. R. Anderson Tile Co.
San Francisco, Calif.

(Can our readers and their firms offer any assistance in this matter?—Editor)

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identity of the writer will be withheld, if desired.

—The Editor

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GENERAL PURPOSE PHENOLICS

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AVAILABLE IN **STANDARD** AND **AUTOMATIC**
MOLDING PRESS GRANULATIONS

A versatile and dependable molding compound, Plenco 308 is excellent for a wide variety of general purpose molding applications. Plenco 308 is also noted for its wide preheat latitude, excellent finish and dimensional stability.

Many molders standardize on this compound because they have found that several flows, 90 and 120, for example, bracket their requirements nicely, and their inventory control problems are minimized accordingly.

As you know, flash sticking on vents can mean lost time and added expense. Recently we have improved the mold and flash release of Plenco 308 to the delight of press operators and users of automatic presses. Like them you, too, may find this compound the answer to your own needs.

IF PHENOLICS CAN DO IT—

plenco

CAN PROVIDE IT
already-made or specially-made

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PLASTICS ENGINEERING COMPANY
Sheboygan, Wisconsin

Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins.

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For complete information and ordering... Write or call our nearest office. Enjay's extensive laboratories and expert staff of technicians are always ready to help with any compounding or processing problems. Shipments can be made in tank car, truck, or 55-gal. drums.

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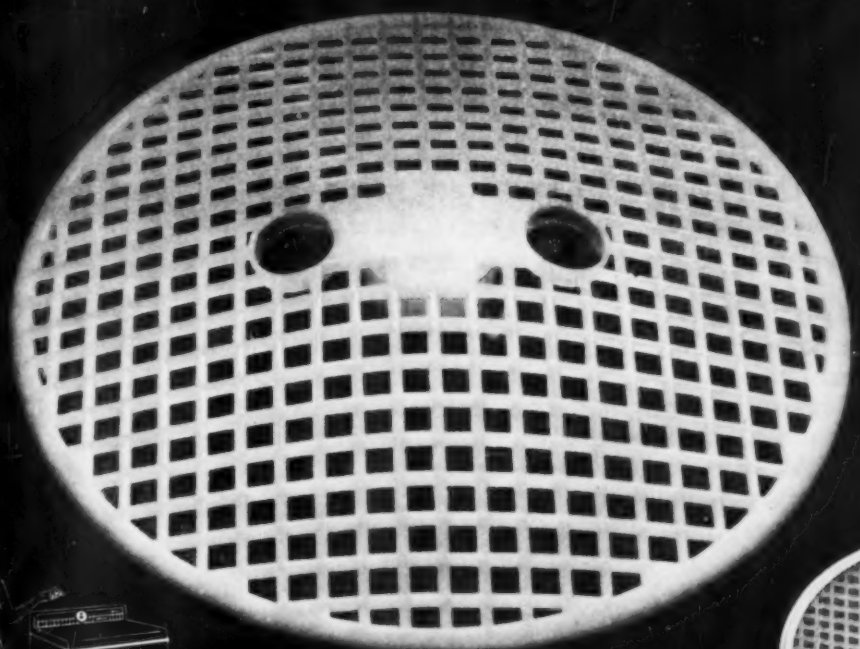
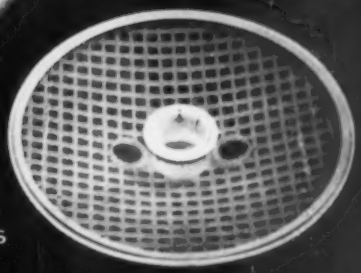
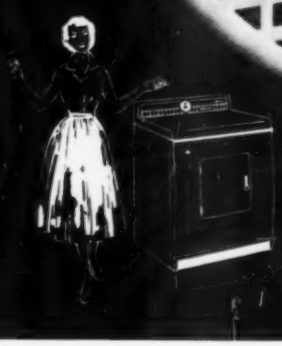






LINT SCREEN FOR GAS AND ELECTRIC DRYERS

MOLDED IN CELANESE FORTIFLEX BY THE GENERAL INDUSTRIES COMPANY, INC., ELYRIA, OHIO

Maytag Lint Screen has new toughness, heat-resistance . . . in Fortiflex

When Maytag required a material for the lint screen in their new gas and electric dryers, they sought one that would give them new rigidity and toughness, more heat-resistance . . . and they found it in Fortiflex. The high temperature-resistance of this high-density, linear polyolefin plastic extends to sterilization levels. Fortiflex is five times more rigid than conventional polyethylenes, and it has the necessary smooth, lustrous surface to handle laundry gently.

Fortiflex "A" is presently available in four melt indexes developed to accommodate a wide range of conditions and applications of interest to designers and manufacturers. For more information and/or test quantities, just use the handy coupon.

Celanese® Fortiflex®

TYPICAL PHYSICAL AND CHEMICAL PROPERTIES OF FORTIFLEX

Properties of Fortiflex "A" Related to Melt Index

PHYSICAL PROPERTIES	ASTM METHOD	UNITS	FORTIFLEX RESINS A-20	A-70	A-250	A-500
Melt Index	D-1238-52T	—	0.2	0.7	2.5	5.0
Heat Distortion Temp. (66 psi)	D-648-45T	°F.	185	185	180	180
Brittleness Temp.	D-764-52T	°F.	—200	—180	—160	—100
Impact Strength, izod (⅛" x ½" injection-molded bars)	D-256-54T	ft. lb./in. notch	23	18	13	3
Tensile Strength, Max., 0.2 in./min.	D-638-52T	psi.	3700	3600	3500	3300
Elongation, First Tensile Yield Point	D-638-52T	%	25	25	25	25

Properties of Fortiflex "A" Not Affected by Melt Index

PHYSICAL PROPERTIES	ASTM METHOD	UNITS	VALUE
Density		g/cc.	0.96
Refractive Index	D-542-50	$N^{25}D$	1.54
Hardness, Shore D	D-676-49T		65
Stiffness	D-747-50	psi.	150,000
Water Absorption (⅛" specimen, 24 hrs. immersion @ room temp.)	D-570-54T	%, wgt. gain	<0.01
Flammability	D-635-44	in./min.	1.0
*Mold Shrinkage, length		in./in.	0.03 to 0.05
width		in./in.	0.02 to 0.04

*Measured on injection molded tensile bar. Mold shrinkage depends on part design and molding conditions.

Fortiflex...a Celanese plastic

Canadian Affiliate: Canadian Chemical Co., Limited, Montreal, Toronto, Vancouver.
Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, N. Y. 16

Celanese Corporation of America, Plastics Division,
Dept. 143-A, 744 Broad Street, Newark 2, N. J.

Please send: ☐ more information on, ☐ test quantities of Fortiflex.

Name_____ Title_____

Company_____

Address_____

City_____ State_____

Here's your answer to rising costs

HOW D-M-E STANDARD MOLD BASES CAN KEEP YOUR MOLD COSTS DOWN DESPITE RISING COSTS OF STEEL, LABOR AND TOOLS

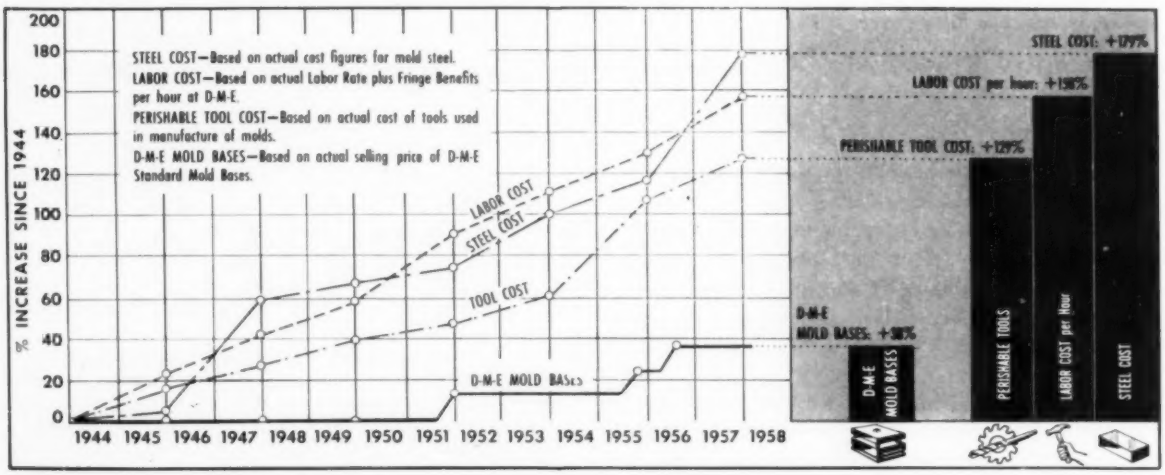
Whether to make or buy an industrial product is one of the most important decisions any manufacturer continually faces. To accurately judge the economy in D-M-E Mold Base standardization, basic cost factors were analyzed dating back to the origin of Standard Mold Bases by D-M-E over 15 years ago. The analysis is plotted on the graph shown below. How these factors affect the cost of the mold is what makes the important difference in whether to make or buy Standard Mold Bases.

Since 1944, the cost of steel has increased 179%; the hourly cost of labor has climbed 158% and the cost of perishable tools has gone up 129%! In the same period the net selling price of D-M-E Standard Mold Bases has increased only a fraction of these amounts.

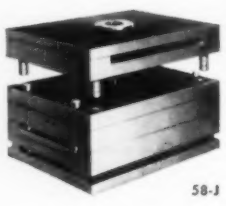
For the mold builder making his own mold bases throughout this period, rising steel, labor and tool costs are reflected in the increased cost of his own finished molds. The savings to the mold builder who long ago recognized the advantages of Standard Mold Bases, become immediately obvious.

The company using D-M-E Standard Mold Bases today not only saves money NOW, but can rely on a more stable cost factor for anticipated mold building programs. At the same time investment capital is freed for equipment more suited to special requirements.

Why it costs less to buy D-M-E standard mold bases than it does to make your own



WRITE FOR the April issue of the D-M-E News giving complete details on "How to reduce mold costs". Or contact your nearest D-M-E Branch for the 170 page Catalog of Standard Mold Bases and Moldmakers' Supplies. Start saving Now!



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- DETROIT: 6686 E. McNichols Rd.—CHICAGO: 5901 W. Division St. HILLSIDE, N.J.: 1217 Central Ave.—LOS ANGELES: 3700 S. Main St.
- D-M-E CORP., CLEVELAND: 502 Brookpark Rd.—DAYTON: 550 Leo St.
- D-M-E of CANADA, TORONTO, ONT.: 156 Norseman Ave.

PLASTICS TECHNOLOGY

JANUARY, 1959

EDITORIAL: The Outlook for 1959

All indications are that 1959 will see the setting of new record highs by the domestic plastics industry. As predicted by The Society of the Plastics Industry, the industry will use approximately 5,000,000 pounds of plastics raw materials this year, an increase of about 10% over the 1958 totals.

Equally optimistic views are expressed by major plastic materials supplier companies in the eight specially-written statements by selected spokesmen in this issue (see pages 23-28). In these statements, the industry is urged to recognize and meet its responsibilities to produce and market the true values inherent in plastics products.

In the words of C. B. Branch, of Dow, "Maturity carries its own obligations. Proud as we are of (our industry's) growth, we must assure the coming generation of a proper environment. . . . Now we are expected to make a contribution to the common welfare."

G. A. Fowles, of Goodrich Chemical, says that 1959 will provide new challenges to the plastics industry, but will give the industry one of its better years. A. W. Hanmer, of Durez, states that 1959 will unquestionably see new highs established in the industry. E. F. Hinner, of Hercules, agrees with this forecast and urges everyone in the industry to work together and open up the many outlets yet untapped by plastics.

E. J. Sullivan, of Borden, also thinks that 1959 should be a good year for plastics, but warns against the danger of users mistaking the normal leveling off of industry in general for another recession. Similar optimistic predictions also are expressed by G. R. Vila, of United States Rubber, E. W. Ward, of Celanese, and George Wash, of Phillips.

Summing up the above predictions and all other sources that we receive, it seems assured that 1959 will be a good year for all plastics materials, whether molded, expanded, or otherwise processed, fabricated and finished. Plastics will continue their strides into previously untouched or restricted fields.

In these applications based on engineering suitability, such as building and construction, automobiles, and the new field of missiles where resistance to high temperatures is required, plastics will do much to replace conventional materials (both metals and woods) for time-honored usages and also new applications that could not be fulfilled adequately by any of the older materials.

●

Plastics are now acquiring the status of true engineering materials made by a mature industry. While aware of the obligations and responsibilities inherent in maturity, we all are very proud to be members of a rapidly growing industry.

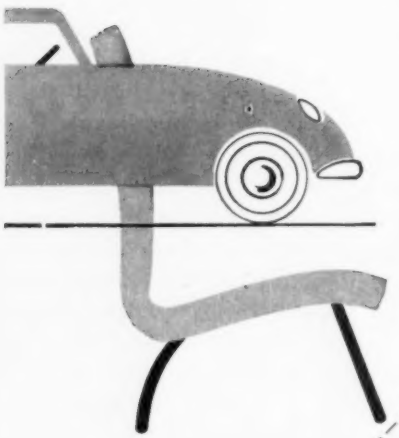
Plastics have made great strides to date, but we are anxiously looking forward to future gains in materials and processing techniques that will help in the building of the "best of all possible worlds!"

Arthur M. Merrill

Editor

HARSHAW

Cadmium Lithopone



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and

REDS

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For colorful products in rich deep tones or delicate pastel tints, use Harshaw cadmium pigments.

The chemical and heat resistance of cadmium yellows and reds combined with their complete insolubility make them excellent for use in plastics, printing inks and industrial finishes.

CORRESPONDING SHADES OF CONCENTRATED C. P. CADMIUM PIGMENTS ARE ALSO AVAILABLE

THE HARSHAW CHEMICAL COMPANY

1945 EAST 97th STREET • CLEVELAND 6, OHIO

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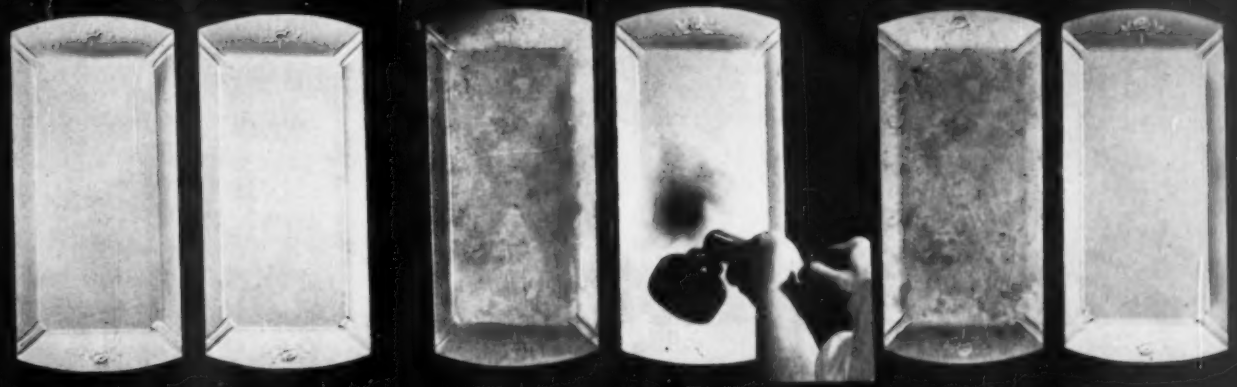
NOW NEW FIRST and ONLY

static dissipating styrene molding powder

LUSTREX LO-STAT

Translate this test into new production economies and sales advantages:



1. Two trays from same mold. Left: molded of standard material. Right: molded of Lustrex Lo-Stat.

2. Charcoal dust is sprayed on both trays.

3. Result! Dust pattern on standard tray corresponds to static electric charge. Tray of Lustrex Lo-Stat is practically clean. The little charcoal remaining is easily tapped off.

Think what Lustrex Lo-Stat can mean in keeping housewares clean and appealing, how much longer signs, displays and packages will stay attractive. Air conditioner and fan grills are other moldings that will be improved. There are dozens of jobs that Lustrex Lo-Stat dust-resistant styrene can do better. And production economies include the elimination of spraying and bathing; open storage and simplified handling. Lustrex Lo-Stat is in full production. Send for a trial quantity now along with complete technical data. Monsanto Chemical Company, Plastics Division, Room 364 Springfield 2, Mass.

Monsanto

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Look
at
THESE
IMPROVEMENTS
they're
today's
big news
in

Rigid

No thermal decomposition

This new process overcomes the disadvantages of conventional methods—allows the use of compounds containing resins and stabilizers much too heat-sensitive for long-cycle methods. Even the higher molecular weight resins suffer no degradation in chemical and physical properties! Special equipment is not required and a wide range of new products, with PVC's distinctive properties, are now possible!

95° higher temperatures

As a typical demonstration, rigid PVC is electronically pre-heated to temperatures of 445°F in about 4 minutes. Previously, maximum temperature was 350°F, with 44 minutes of total exposure. High frequency pre-heating, together with plunger molding, allow a faster rigid PVC molding cycle. This includes heating to the critical temperature range, molding and cooling.

62.5% lower pressure

By contrast with the 40,000 psi. pressure usually associated with injection molding of rigid polyvinyl chlorides, this new process calls for plunger molding with only 15,000 psi. pressure. Essentially a one-shot process, with time and temperature carefully controlled, the technique avoids prolonged exposure of the PVC material to heat and eventual decomposition.

More complex shapes —thinner sections

And markedly improved gloss, better weld strength and more uniform, splash-free surface appearance are end-product advantages of the new techniques. All these and other advantages are described in Technical Bulletins available from your Union Carbide Plastics Company Technical Representative. *Ask him particularly about the application of this new technique to* "Bakelite" Brand *PVC materials.*

PVC Molding

UNION CARBIDE PLASTICS COMPANY

Division of Union Carbide Corporation
30 East 42nd St., New York 17, N. Y.

UNION CARBIDE

In Canada: Union Carbide Canada Limited, Toronto 7, Ontario

The terms BAKELITE and UNION CARBIDE are registered trademarks of UCC.

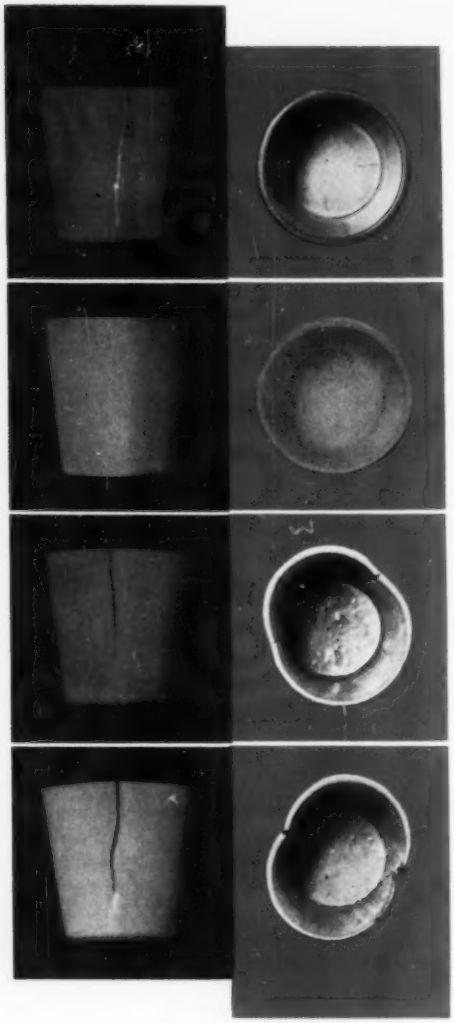
UNRETOUCHED PHOTOS

DRAMATIC PROOF

of DAPON® resin's outstanding stability under heat and humidity

As graphically shown here, Dapon Resin does not distort, degrade or discolor under long exposure to high heat and humidity. This outstanding dimensional stability, coupled with Dapon Resin's high electrical properties and chemical stability even under extreme conditions, may provide the answer to your high-temperature high-humidity plastics stability problems.

Dapon Resin is easily compounded with a wide variety of mineral and fibrous fillers and has extremely low molding and post-mold shrinkage. And in addition, Dapon Resin can be molded in a range of solid and pastel colors.



MELAMINE "A"
after 10 days
under test

DAPON
after 90 days
under test

POLYESTER "A"
after 18 days
under test

POLYESTER "B"
after 22 days
under test

TEST DATA: An equal number of test cups were molded under normal conditions from commercial polyester, melamine and DAPON Resin. The cups were half filled with tap water and placed in a laboratory oven at a constant 212°F temperature, the water being replaced daily. The cups were examined at regular intervals and removed from the oven when they had reached the condition shown in the unretouched illustration.

At your request, we will be glad to send you complete technical data on Dapon Resin so that you can investigate this unusual plastic as the answer to your specific problems.

Properties of DAPON* Resin

Stable, free-flowing white powder • Easy to store, easy to mold, easy to color • Molded products have excellent surface finish • Good physical strength • Low moisture absorption • Chemically resistant • High-temperature and high-humidity resistance • Outstanding dimensional and chemical stability • Fine electrical properties even at high-temperature and high-humidity.

**DAPON Resin is the registered trade name of Food Machinery and Chemical Corporation's brand of diallyl phthalate prepolymer.*

fmc
FOOD MACHINERY AND CHEMICAL CORPORATION ®

Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION
Chemicals and Plastics Division
161 EAST 42ND STREET, NEW YORK 17, N.Y.

NEWS in BRIEF

Production of plastics and resin materials in 1958 reached a new high of approximately 4,544,000,000 pounds, 5% above the previous year, according to SPI. Last year's value of plastic products was about $2,272-million, as compared with $2,164,000,000 in 1957. A comparison of 1958 figures for some plastics raw materials with 1957 totals showed the following: cellulosics, —6%; phenolics, —5%; polyesters, +20%; polyethylene, +30% polystyrene, +5%; urea and melamine, —5%; and vinyls, +2%. SPI estimates that another all-time high of about 5-billion pounds will be set in 1959.

High-density polyethylene has been used successfully for surgical repair of tissue defects of the chest and abdominal wall. A surgical mesh of the material meets all requirements for an inert plastic prosthesis that sets up very little foreign-body reaction. Successful applications have been in replacing tissues losses by hernia operations and to replace large tissue defects resulting from the excision of tumors. With the latter, firm but pliable fibrous tissue replacement was obtained with the plastic mesh.

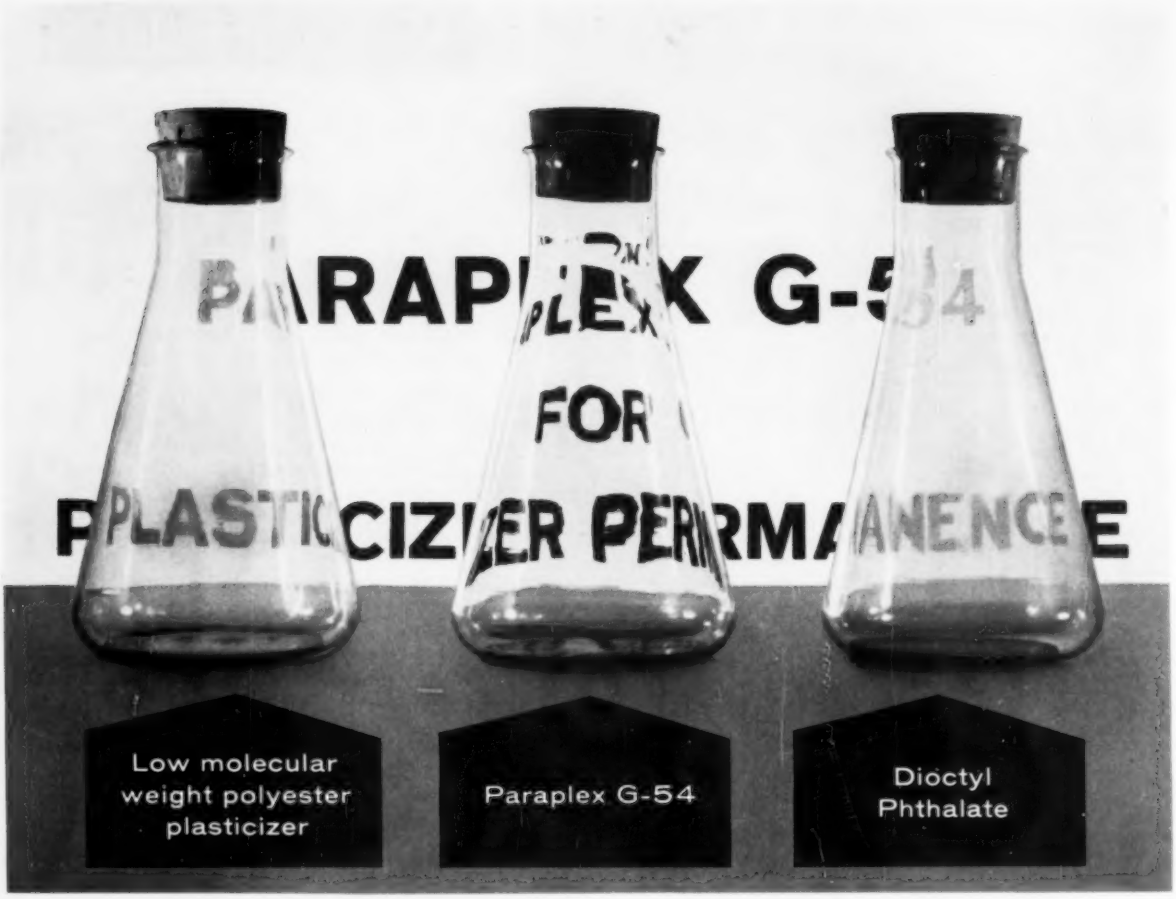
Business developments in the plastics industry ended 1958 in fine style. A new blow molding company, Air-Formed Products Corp., was established in Nashua, N. H., for the molding of toys, housewares, and containers. A Midwest regional sales office was set up by Catalin Corp. in Chicago, Ill. W. R. Grace and Columbus Plastic Products set up an agreement that makes it possible for resin suppliers to obtain sub-licenses from Grace for that firm's valve grating method of injection molding. Johns-Manville Fiber Glass, a newly formed subsidiary of Johns-Manville Corp., will purchase the assets and business of L.O.F. Glass Fibers Co. Plastic Materials, Inc., and Thermo-Plastic Materials, Inc., set up Poly-Blends custom blending and compounding services for blow molders. Standard Insulation Co. has been purchased by C. H. Dexter & Sons, Inc., and will be operated as a subsidiary by which the new owner enters the field of laminations, coatings and reinforced plastics.

Company expansions in plastics continue in the news. New and larger quarters have been occupied by Bel-Art Products in Pequannock, N. J. Borden opened a new addition to its PVC plant in Leominster, Mass., and has scheduled two new plants for 1959 openings; a costings and adhesives plant in Illiopolis, Ill., and a PVA plant adjoining existing facilities at Leominster. Interchemical opened a color,center in New York City for basic research, consultation and information on colors. Mobay plans to increase its capacity for tolylene diisocyanate chemicals at New Martinsville. W. Va. Reichhold is building a new formaldehyde-producing plant in Kansas City, Kan. Sommers Plastic Products opened a new distribution center for vinyls and coated-vinyls in East Rutherford, N. J.

New Materials that merit attention (see pages 65-7): silicone-glass laminate material; series of contact cements based on elastomers and synthetic resins; fungicidal and fungistatis additive for PVC compounds; two polymeric plasticizers; and an odorant for butyrates.

New Equipment of special interest (see pages 68-72): solids flow valve; sleeving cutters for insulation tubing; automatic, pneumatic guns for spot-glue applications: two industrial cutting knives with locking handles; high-speed, pneumatic die grinders; combination extruder-injection molding machine; portable attachment for converting an electric hand saw into a chop saw for plastics; and ball-type shut-off nozzle with removable tip for injection molding of nylon.

Plastics Applications to be noted (see pages 73-5): insulator molded of glass polyester; slide projector housing molded of high density polyethylene; unsupported thermoplastic films with superior clarity and gloss; micaaceous insulation using epoxy resin binders; vinyl conveyor belt for industrial castings; urethane-foam tape with adhesive backing; polyethylene barbells, with hollow weights; throw-away package with polyethylene liner for electrolyte shipping; nylon-reinforced vinyl garden hose; molded polystyrene wall brackets; and post forming-grade Micarta.



Low volatility means long-lasting toughness and flexibility for vinyls

The clear flask tells the story of PARAPLEX G-54. Fogging in the other flasks is lost plasticizer. It condensed on the glass after being driven out of vinyl samples by exposure to a 250-watt heat lamp for 16 hours.

All three vinyl samples are the same, except for the plasticizer. They were cut from 0.035 in. milled vinyl sheets. The test simulates the effects of hot sunny weather. It compares with actual service conditions for upholstery, electrical insulation and applications which must withstand heat and high humidity.

The visual evidence here shows why PARAPLEX G-54 gives vinyl compounds longer-lasting flexibility. Low volatility also means less loss of plasticizer at higher milling temperatures. In addition, PARAPLEX G-54 is resistant to exudation at high temperatures and high humidity, and extraction by soap, detergents, oils, and gasoline. In other words, PARAPLEX G-54 is the plasticizer that stays *in* vinyl compounds when other plasticizers won't.

Write today for descriptions of the many ways of using PARAPLEX G-54 and the other PARAPLEX and MONOPLEX plasticizers made by Rohm & Haas.

Chemicals for Industry

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

PARAPLEX *and* MONOPLEX *are trademarks, Reg. U.S. Pat. Off. and in principal foreign countries.*

PARAPLEX G-54

U.S.I. POLYETHYLENE NEWS

A series for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

JANUARY 1959 — U.S. INDUSTRIAL CHEMICALS CO., DIVISION OF NATIONAL DISTILLERS AND CHEMICAL CORP., 99 PARK AVE., N. Y. 16, N. Y.

Packaging Notes

Poly Cap for Lighter Fluid and Household Oil Cans features a valve spout that moves on an undercut track. The undercut design gives a tight seal which prevents both leakage and evaporation loss. The cap, which was developed after two years of testing, takes advantage of polyethylene's tendency to swell in contact with lighter fluid. The undercut valve component and undercut cap base both are designed to effect a tighter seal when swelling occurs. The caps are press-fitted to the cans with conventional polyethylene press-fit machinery.

Polyethylene gloves, strong enough to be reusable and inexpensive enough to be disposable, are now being marketed for both home and industrial use. The gloves are made of 1.75 mil polyethylene. Although strong, they do not impair the sense of touch as do gloves of other materials. They are presently being packaged in pocket packs of four and in economy rolls with up to 144 gloves on a roll. They are available in heavier gauges for industrial applications. The gloves reportedly have been cleared for use with radioactive materials by a leading radiation laboratory.

Gloves of 1.75 mil polyethylene are being packaged in economy rolls of up to 144 per roll and are available in heavier gauges for industrial applications.

"Woven" Polyethylene Bags for packaging citrus fruits and other produce may make their appearance soon. Poly strands are laid at intervals of about ⅜ths of an inch, then are heat-sealed to similar strands laid across them. The effect is an open, latticed material which has considerable strength. Decorative effects are obtained with strands of different colors.

Poly bag with two compartments separated by a simple polyethylene check valve permits dry premixes to be packaged in ready-to-use form. User simply adds liquid to upper compartment, squeezes it into premix compartment, then wet mixes the ingredients by kneading the bag. Check valve prevents leakage of contents. Products for which the newly patented package design is suggested include cake, pie crust and bread mixes, other wettable formulations such as glues, cements and plaster.

U.S.I. Holds Polyethylene Conference For Export Agents from Around the World

Discuss Latest Technical Developments, Growing Overseas Markets

Export agents representing 20 overseas markets were the guests of U.S.I. at a seven-day conference that included meetings in New York, Tuscola, Ill., and Chicago. Purpose of the conference was to review the latest developments in polyethylene technology and to discuss the rapidly growing markets for polyethylene abroad.

Export agents from 20 countries disembark from plane prior to visiting U.S.I. plant at Tuscola, Ill. for first-hand view of polyethylene resin production.

The 24 visitors represented markets which accounted for almost 75 percent of total U. S. polyethylene exports during the first six months of 1958. Represented were most of the European countries, South and Central America, the Far East, Near East and Mexico. Last year, U. S. polyethylene sales in these areas ran some 20% ahead of 1957, and further increases have been predicted.

After sales orientation meetings in New York, the conferees visited the giant petrochemical complex at Tuscola, where U.S.I. makes its PETROTHENE® polyethylene resins. U.S.I. research and production experts gave a series of lectures designed to bring the overseas visitors up to date on the latest developments in polyethylene resin production and processing.

The visitors moved on to Chicago for additional meetings and a press reception with editors of leading American plastics publications. The export representatives stayed on in Chicago to attend the National Plastics Exposition and the International Dinner of the Society of the Plastics Industry.

Poly Film Packaging Cuts Weight Losses in Peaches

Preliminary research conducted at a leading midwest agricultural experiment station indicates that prepackaging peaches in polyethylene film can cut weight losses in peaches which must be shipped over long distances.

In the tests, peaches were placed in plastic trays and overwrapped with perforated poly film. Weight losses during cold storage were reduced by 60%. Surface shriveling and dullness, usually encountered in bulk handling, were found to be eliminated in peaches which were packaged in film.

A controlled ripening schedule, in which the packaged peaches were ripened after a week in cold storage, was found to improve quality and reduce incidence of storage rots.

Borated Polyethylene: Order 6-8 Weeks in Advance of Use

Users of borated polyethylene are advised to schedule their orders six to eight weeks in advance of their projected use dates. The compounded resin picks up moisture from the air and must therefore be used within a short time after preparation. The six to eight week lead time on orders enables U.S.I. to schedule production for this specialized grade and insures delivery as close as possible to actual use date.

New Press Permits Printing Poly Film in Continuous Roll

A new printing press has been developed which enables polyethylene film to be printed in two colors at high speed without the need for stopping or reducing speed to join rolls.

Each reel stand of the new flexographic press carries two film reels, each independently driven. By synchronizing the speed of the full reel with the empty reel, the press permits a pasted joint to be made with no interruption or slow-down.

Speed of the press is said to be more than 450 feet per minute. The press is equipped with unit driers, a rotating mirror and web scanning device, static eliminator tension control and automatic paster on both unwind and rewind ends. The press will print two colors, with two more colors possible through the attachment of another unit.

LITTLE OR NO WASTE

WHEN YOU SHUT DOWN WITH A PETROTHENE® RESIN PURGE

If you extrude or injection-mold polyethylene, you no longer have to put up with rejects or costly scrap when you start up a cold machine. Feeding U.S.I.'s new PETROTHENE® 205-1 special "Shut-Down" polyethylene resin to the machine a few minutes before shut-down minimizes production losses on start-up.

With PETROTHENE® 205-1, such problems as gels, fish-eyes, off-color, and other resin deterioration signs that often show up for hours after start-up will be remarkably decreased. That's because it has been specially prepared to withstand prolonged exposure to high temperature. Thermal degradation is inhibited when 205-1 is held in the machine during cooling and heating periods that follow halts in production.

This special resin is simple to use. A few minutes before shut-down, it is fed to the machine until the normal resin has been purged. Since production at start-up is often usable, there is little or no waste. PETROTHENE® 205-1 is supplied in pellet form, packed in 50-lb. bags.

For more complete details on how you can reduce post-start-up scrap with this special shut-down resin, contact your nearest U.S.I. office, or write:

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.
Branches in principal cities

Thermolite 112

FOR PREMIUM STABILIZATION AT NO EXTRA COST

Thermolite 112 is a **different** liquid barium-cadmium stabilizer—free of fatty acids, outstanding in its heat and light stabilizing action. Its completely aromatic structure gives outstanding compatibility —**no plate out** in calendering or extrusion.

In calendering, Thermolite 112 gives clear films without any plate out on the rolls. Vinyl compounds with sensitive pigments will not drift in tone during calendering.

Extrusions run longer and clearer without plate out on dies, therefore, no expensive machinery down time—**a plus factor** with Thermolite 112 stabilizers.

In plastisols, Thermolite 112 with Thermolite 166 gives a powerful heat and light stabilizer combination with excellent viscosity characteristics and good air release.

Also available are two auxiliary stabilizers which may further improve your plastic products: Thermolite 180, a purely organic stabilizer and powerful antioxidant, and Thermolite 166, a liquid zinc stabilizer.

For information on these or other Thermolite Vinyl stabilizers, write Metal & Thermit Corp., Rahway, N. J.

Thermolite

STABILIZERS FOR ALL PURPOSES

The WEI Dual Worm Design Makes The Most "Successful" Processing Sense

Some of the important materials being processed on WEI Dual Worm Compounder-Devolatilizer-Extruders:

POLYSTYRENE
POLYSTYRENE COPOLYMERS
ABS MATERIALS
LOW DENSITY POLYETHYLENE
HIGH DENSITY POLYETHYLENE
ACRYLICS
POLYCARBONATES
KEL-F
PHENOLIC MOLDING POWDERS
HOT MELT ADHESIVES
MELAMINE MOLDING POWDERS
POLYVINYL CHLORIDE
POLYVINYL ACETATE
POLYVINYL BUTYRAL
POLYPROPYLENE
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Confirmation for such a basic claim takes clear form on the production lines of the world's foremost plastics manufacturers. By unique ability and almost limitless flexibility WEI compounder-devolatilizer-extruders continue to confirm the confidence of men who must tackle the toughest jobs in the industry and must make their tackling pay off in both profits and reputation.

When you, too, face a challenging future and need the most trustworthy, dependable, reliable equipment your money can buy . . . investigate WEI. We consider your materials and processes strictly and permanently classified.

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Be an important and profitable step ahead of competition—adopt WEI dual worm compounding-devolatilizing-extruding equipment . . . Write for Brochure No. 891.

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PLASTICS TECHNOLOGY

The Outlook for 1959

In a series of specially written statements by eight industrial leaders, the plastics industry views and predicts its prospects for 1959.

C. B. BRANCH, *Mgr.*
Plastics Dept., The Dow Chemical Co.
Midland, Mich.

THE great promise of the coming year for plastics is in the fruition of process and application technology. The great challenge lies in recognizing and effectively discharging our responsibilities to produce and market the true values inherent in plastics products.

Maturity carries its own obligations. Proud as we still are of our growth, we must assure the coming generation of a proper environment. The decisions we make in these first years of maturity will have a profound effect upon our progeny. No longer do we have to make the industrial community aware of our presence; now we are expected to make a contribution to the common welfare.

To realize the promise of 1959, we shall need help, vision, and well-organized plans. Technically, designers and engineers in our customer industries still are pressing the plastics industry for better information and practical measures of the values unique to plastics. As these designers and engineers come to understand and apply plastics as basic engineering materials, new standards of value appear in the products they make. By virtue of their own industry responsibilities, they contribute objectivity and perspective. But we have to tell them—in their own language—what is significant in our fast-moving technology. Designers and engineers will accelerate the trend toward combining two or more plastics in the coming year. To the strength and bulk of low-cost materials, they will integrally form surface materials of greater cost than would be warranted in one material alone. The resulting combination of properties and economy will open whole new fields of application.

A continuing drive toward job simplification will lower costs and improve products. We shall see two

parts molded together more frequently; decorating and printing done at the time of molding; and a constant re-look at job stations with a view toward eliminating steps or combining them right into the plastic process. Increasingly, machines will be designed for specialized jobs. Materials handling will continue to improve so that material produced by the ton will not be handled by the ounce.

Whatever the promise of these products and processes, the immediate future commands attention to the marketing and distribution of manufactured plastics goods. No longer can whole industries temporize with chaotic standards and misapplication. Competition for consumer dollars and a place in the market will exact heavy penalties on those who fail to deliver value. Fortunately, responsible and effective ground work already has been developed in the areas of greatest growth for 1959. Plastics will contribute new standards of value and efficiency in packaging, industrial molding, and in the construction industry in the coming year.

The potential for plastics in packaging is perhaps the greatest single challenge. Both flexible and rigid types are demonstrating ability to grow by dramatically increasing the sales appeal of the products they contain. The development of films and foams is forcing a revolutionary change in traditional distribution methods for many industries. They are succeeding because the values they contribute are intrinsic and recognizable by consumers and manufacturers alike.

Molded plastics have seen so many advances in raw materials development that some markets seem to have been motivated more by newness than by practical application. Polystyrene and polyethylene continue to serve the major needs of countless thousands of products. Their infinite capacity for modification and adaptation will make it more possible than ever to tailor the proper combination of properties to the needs of the end-usage. Housewares and toys will increase their consumption, while establishing new demands for polyolefins and low-cost foams. Appliance manufacturers, too, should increase their demands for these and other basic plastics, since they both improve products and lower costs. Expanded plastics, epoxy resin systems, and better processing methods undoubtedly will strengthen our position here.

The building and construction industry presents one of the greatest opportunities for plastics. Long considered purely decorative, new plastics products are fulfilling increased functional requirements. Despite building codes, methods and exacting structural needs that limit the opportunity for change, a long evolutionary step in favor of plastics should be taken in 1959. Roofing, insulation, and surfacing materials will progress rapidly. Panel and curtain-wall assemblies will speed construction and prove their economy. A whole new field of pre-form architecture lies ahead, with plastics fulfilling a true structural role in combination with traditional materials. Our greatest tasks are to publicize the benefits of these new tools and to provide an economical distribution system for the plastics which will be used.

In the coming year, the dynamic spread of plastics applications will depend on how we will communicate with those who best can benefit from our products and services. Ideas imparted to others take root in unlimited new combinations of ideas. The more thoroughly we can communicate our ideas, the more help and acceptance we can expect for plastics. —THE END

G. A. FOWLES
Manager, Plastic Materials Sales
B. F. Goodrich Chemical Co.
Cleveland, Ohio

THE plastics industry has been through many periods of adjustment in its relatively short life. This last year was another period of catching our breath before invading additional industries and spreading to broader fields of plastics application.

While 1959 will again provide new challenges to the industry, it is our belief that the industry will experience one of its better years and that the familiar growth trend in sales and new applications will continue.

Two major factors are inherent in predicting this continued growth in 1959. One, the continued recovery of the nation's economy which is well under-way; and two, increasing competition between the many new materials, as well as competition from new producers in the industry.

The last quarter of 1958 found the plastics industry recovering at a rapid rate. Our confidence in the future is heightened further by the continued rapid rate that the industry demonstrates in finding new applications for plastics in every field.

Increased Automotive Production will certainly add sales for the plastics industry. The use of plastics in automobiles is expanding into more parts and applications each year. If auto production in 1959 is up 30% over 1958 as may be expected, this increase alone will have a real impact on the sales of plastics to the industry.

Construction Programs (residential, commercial, and industrial) will help to increase the use of plastic materials in interior applications, and the expanding

should call for supplemental materials in outdoor construction.

Competition in the plastics industry grows keener each year. The number of producers of vinyl resin, for example, has more than doubled in the last six or seven years. In many product lines, there is a resultant overcapacity. It behooves us to utilize more of the existing capacity profitably by finding new applications and new markets. Thus, a vigorous and continuing research and development program by both raw materials producers and processors assumes increasing importance, and is the key to our continued growth.

Inflationary cost trends, when coupled with price pressures brought about by the highly competitive market in raw materials and plastic products, are compelling the manufacturer to reduce his overhead to the minimum. The success of everyone in continuing his growth will depend upon how well costs are handled, while staying competitive. Intelligent marketing and concerted efforts by the plastics industry toward well-engineered products will help to maintain and improve the growth rate in 1959.

—THE END

A. W. HANMER, *Jr., Genl. Sales Mgr.*
Durez Plastics Div., Hooker Chemical Corp.
Niagara Falls, New York

THE year 1959 will unquestionably see new highs established in the plastics industry. The minor recession of 1958 is a thing of the past and, while no boom is anticipated, a good business climate should generally prevail.

In the phenolic industry, the Durez Plastics Division of Hooker Chemical Corp. anticipates a sizeable increase in business over that of the past two years. Phenolic materials possess properties of heat resistance and dimensional stability found in no other plastic and, thus, will continue to grow with the growth of the industrial economy and consumer durables.

The trend toward integrated departmental molding will continue. Thus, even more activity in developing new applications and uses will be required on the part of the custom molder in order to maintain and expand his business. Current Durez advertising and sales programs are designed to assist him in this effort.

The phenolic resin industry is one of almost daily change. Old established uses continue to grow with the economy while new applications, unheard of a few years ago, continue to develop as more and more industries are made aware of the versatility of phenolic resins in their various forms. Primarily binders, phenolic resins impart a host of improved properties to the countless products in which they are used. Imagination plus research is the key to their growth, and they should be investigated thoroughly by everyone interested in costs and improvement of product. In the form of either liquids or solids, practically every industry can use phenolic resins to advantage.

The reinforced plastics industry, involving primarily polyester resins and fibrous glass, will continue its growth in 1959. The Durez Hetron® polyester resins are entering more and more fields heretofore closed to polyesters because of fire hazard, since Hetrons are inherently fire-resistant and self-extinguishing. The unusual specifications of Hetron resins, when combined with progressive thinking, dictate the use of such materials in a wide range of polyester applications.

We see nothing on the immediate horizon to alter our belief that 1959 will be a good year for the plastics industry.

—THE END

THERE is every reason to believe that 1959 will be a good year for the plastics industry, and for the new plastics now being sold by Hercules. In the course of the past year, all three of our new materials have been in the process of establishing themselves in areas where they can be most effectively employed.

The position of our first polyolefin, Hi-fax®, high-density polyethylene, is now clearly defined. Bottles and containers, wire and cable, pipe, and industrial extrusions are among the major markets where Hi-fax appears to offer a product superior to any other currently available. Likewise, I believe we have in Penton® chlorinated polyether, an outstanding new material which is a "natural" for anti-corrosive uses, and we expect to see the greatest short-term growth in the use of this new product in molded, extruded, and fabricated components for processing systems.

On the other hand, the potential spectrum of uses for our Pro-fax® polypropylene is so broad, that although this versatile new material has already kindled interest in many fields never previously served by plastics, many of its future applications—and possibly the largest in volume—may well lie in directions no one has considered to date. Both the appliance and auto-

E. F. HINNER, *Genl. Mgr.*
Cellulose Products Dept.
Hercules Powder Co.
Wilmington, Del.

motive industries have been quick to capitalize on the low-cost combination of properties Pro-fax offers them. A multitude of industrial uses are either in the design or mold construction stage, or are already in commercial production. There is a good indication that Pro-fax, either molded or thermoformed from sheet, will find wide application in the luggage industry, while both film and monofilament represent significant markets already on the horizon. The entire packaging field offers tremendous possibilities for all of our new plastic materials, which may find themselves in use as containers, closures, wraps and paper-coatings, very often replacing traditional materials such as glass and metal.

Perhaps the most remarkable fact about the present plastics picture, and the apparent direction in which we are moving, is the big shift that is now taking place in the selection of basic materials for product design. There has been a slow but definite trend in this direction for many years. Now, it is being rapidly accelerated. Literally, hundreds of things are changing from the traditional materials of the past (wood, metal, and glass) to synthetics which can provide not only superior properties, but lower-cost processing methods. This holds true for the plastics industry as a whole, and particularly for our own new plastics, all of which are making steady inroads on markets previously held by non-plastic materials.

Obviously, this is the way that our industry can find its soundest and most rewarding growth—not by fighting among ourselves for the relatively-limited amount of business offered by markets that already are defined, but by working together to open the many outlets yet untapped by plastics. This is the direction in which Hercules will move in the months ahead. I trust others will join us. If they do, the plastics business will be better than ever in 1959.

—THE END

EUGENE J. SULLIVAN, *Exec. Vice-Pres.*
The Borden Chemical Company
New York, N. Y.

INCREASED popularity of plastic products, especially in the packaging field, is almost certain to spell a good year for the plastics industry in 1959.

We know that the over-all U.S. consumption of resins and plastics jumped from an annual rate of about one-billion pounds in 1946 to approximately five-billion pounds. As new uses are found for the plastics—and the new uses are being found every day—the industry will capitalize on its discoveries. And as the population continues to grow, production will have to be stepped up sharply to meet demand for these new products. Naturally, the industry will increase its research programs to develop new products and new plastics applications.

Although we expect the industry to prosper during 1959, we are aware of at least one danger which, unfortunately, is purely psychological. Remembering that business in general was depressed early in 1958 and that the spurt in the last half was the result of a rebuilding of inventories, it follows that sales should slow as the new year gets under way. If this proves true, some purchasers may misinterpret the normal leveling off as the sign of another recession. Should such a feeling become prevalent, the industry certainly would suffer. It is unlikely that such a course would prove fatal, but it could change what definitely should be a great year to merely a good year.

We at Borden are highly optimistic, however, for the industry as a whole and for our own company especially. Sales of our standard and specialty resins have increased steadily over the years. We have no doubt that the trend will continue—and that recent developments, plus some still in the research stage, will provide us with new markets and increase our share of existing markets during 1959.

—THE END

RISING sales during the second half of 1958 brought this country's plastics industry out of the swamp of recession with a rush. From the vantage point of the high ground on which the industry now stands, it is

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possible to look ahead a few years and predict trends.

The industry's vinyl makers and fabricators were hampered early in 1958 by lagging sales, but then the sales picture brightened late in the year as demands increased. It is probable that total sales of vinyl resins for 1958 were 634-million pounds, or approximately the level reached in 1957.

Vinyl's outlook is relatively good, at least from the sales standpoint. Some promising new uses have been developed, and are expanding. Examples are the use of rigid vinyl for extruded window frames by the building industry, and the application of vinyl organosols in inexpensive floor coverings. Vinyl's established markets, such as upholstery fabrics and film, are also growing.

This combination of new and old uses should push annual vinyl resin sales to 900-million pounds by 1962. Unfortunately, this will still be below this country's present production capacity for vinyl resins which is near the billion-pound mark.

The polyester resin business apparently went through the 1958 recession unscathed. Sales of this plastic material, used primarily in reinforced-plastics applications, climbed throughout the year (1958) and reached the 100-million pound level by the year's end. Key factor in polyester's success story was the booming popularity of reinforced-plastic boats. More than 70,000 of these boats were built in 1958, an increase of better than 40% over 1957, and almost one out of every four pounds of polyester resin produced in the United States during 1958 went into the marine field.

The long-term outlook for polyester resin sales also is good. This section of the plastics industry is expected to grow over the next few years at a much faster pace than the over-all industry itself. By 1962, polyester sales should be 200-million pounds annually. Boat building will continue to be the major growth factor, but increases also are expected in the use of reinforced-plastic panels by architects and builders, and molded reinforced-plastic parts by the aircraft industry.

The sale of high-impact plastic molding materials also encountered lagging, then rising sales in 1958. Major use for these tough, corrosion-resistant materials is pipe. Recently, these plastics have been used for telephone hand sets, artillery shell casings, grass catchers for rotary lawn mowers, and housings of many types. Sales of these plastics totalled approximately 35-million pounds in 1958. As they expand current uses, and break into additional markets that conventionally have been non-plastic markets, total sales for these resins should reach 70-million pounds by 1962.

—THE END

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Newark, N. J.

IT is difficult to see anything ahead for 1959 but a continuation of the firmly-established growth trend of the plastics industry. The advent of new plastic materials, new applications of older ones, the increase in usage due to population growth, and the normal increase to be expected from generally favorable business conditions all point quite clearly to a profitable 1959 for raw material suppliers, fabricators, and retailers.

Of particular importance is the acceptance of linear polyethylene, which underwent its first real test in the market during 1958. With the problems of design and engineering attendant on the introduction of any new material rapidly being overcome, and with recognition of the functional properties and merchandising advantages of linear polyethylene products gaining wider recognition, it will be surprising if sales of this material do not at least double during the coming year.

While linear polyethylene may well have the most dynamic growth of any molding material next year, smaller but still healthy progress appears probable for most other members of the plastic family. With the re-

search and development efforts of American industry directed toward improving the appearance, durability, strength-weight ratio, cost, and performance of everything from 50-cent toys to 50-million-dollar aircraft, the opportunities for plastics to perform useful services should increase steadily through 1959. —THE END

GEORGE WASH, *Director of Plastic Sales Division, Phillips Chemical Co. Bartlesville, Okla.*

SINCE its start in 1868 when cellulose nitrate, the first commercial plastic, was produced in this country, the plastics industry has maintained a vigorous growth pattern. An even greater success story is now being written by a segment of the plastics field scarcely two years old—linear polyethylene.

Like Jack's magic beanstalk, this new material is shooting up into the domain of the giants. About ten-million pounds were sold in the United States in 1957, and estimates of 1958 sales run between 55 and 65-millions. This amazing growth is even more impressive when viewed against the background of the 1957-58 recession.

Combined sales of all polyethylenes—conventional, as well as the newer linear—are expected to exceed vinyl sales this year to make polyethylene the top-selling plastic. However, there is no magic connected with this phenomenal sales record of linear polyethylene.

The new plastic has such a wide range of superior qualities that it is winning important beach-heads in a continually expanding number of markets. Its resistance to heat and abrasion, as well as its colorability were decisive factors in its selection by a leading power-mower manufacturer for engine shrouds, side deflectors, and discharge shoots in the company's 1959 line. We know that related fields (such as marine engines and motor scooters) are watching this application with great interest.

Clear film made of linear polyethylene was developed this past year. The new filmwrap—sparkling clear, glossy, and with a built-in tear tape feature—promises to offer a serious challenge to the long-held dominance of cellophane in the packaging industry.

The January Housewares Show in Chicago—springboard for mass sales of kitchenware in the coming year—will exhibit complete lines of housewares made of this rigid plastic, which can be boiled or sterilized safely without losing shape or lustre. Marlex—Phillips' linear polyethylene—will withstand temperatures as high as 250° F. and as low as —180° F. This significant factor, among others, has led to interesting experiments with surgical mesh, as well as more mundane applications such as trays, disposal cans, bowls, and the countless other products that make up hospital equipment. The baby-bottle field already has adopted this "sterilizable" plastic.

The cosmetics industry, always on the lookout for new materials, is attracted by certain obvious advantages: Marlex is leakproof, unbreakable, lightweight, and will not absorb odors. Its initial entry in this field is a shampoo container. I feel certain this is only the beginning of a wide-front advance.

The filmwrap is being tested by a baking company. Another food producer, intrigued by rigid polyethylene, is about to market a food tray that can go from the frozen food cabinet to the boiling pot of water in the kitchen.

Rarely has a new material engendered as much excitement and experiment. Meanwhile, research and technological improvements continue. At Phillips, we recently introduced a range of new types of Marlex resins to supplement the five types already in production. The new series offer superior performance in hundreds of new applications, especially in fibers and bottles. For example, these new resins will resist stress-cracking by household agents, such as liquid detergents.

We have only scratched the surface as far as the commercial possibilities of linear polyethylene are concerned. With broadening markets and continuing fruitful research, there seems every justification for optimism in the year ahead. —THE END

Application of Nuclear Energy to the Polymer Field

A comprehensive review of the mechanics of radiation and their application in polymerization reactions for resins.

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WHILE the effects of radiation on chemical systems were first noticed almost 30 years ago, and have been explored actively ever since, it is only during the past decade with the availability of large and relatively inexpensive radiation sources that an extensive applied, as well as fundamental, attack has come into existence.

Various nuclear sources have been used, including: (1). Highly-ionizing, high-energy particles, such as electrons, protons, deutrons, and alpha particles which can be produced by accelerators (such as resonant transformers, Van de Graaf generators, and linear accelerators); (2). The more penetrating and less-ionizing gamma radiation from artificially produced radioactive materials like cobalt-60, cesium-137, iridium-192, and the gross fission-products of spent reactor fuel elements; and (3). Mixed spectrum of particles, electromagnetic radiation, and neutrons obtained by insertion of the sample into the core of a nuclear reactor (pile irradiation).

The choice of a particular radiation source is dictated by economics, availability, and the specific interests and objectives of the organization involved. While somewhat different effects may be observed if different radiation sources are used, the fundamental processes involved are the same. They are simply an extension of photochemical reactions in organic systems—the production of ions and free radicals. As an added benefit, nuclear radiation supplies considerably more activation energy than could easily be obtained thermally or with visible light. Just as in photochemistry where we discuss our results in terms of quantum yields, being careful to specify the wave-length involved, so in radiation chemistry do we specify our

yields by G(A) values (number of molecules of A produced by the absorption of 100 e.v. of energy in the system), remembering to indicate the nature of the incident ionizing radiation.

Effect of Radiation

Since the principal result of the inter-action of radiation with organic material is to form free radicals, it is not surprising that the major effect of nuclear radiations on unsaturated hydrocarbons is polymerization. For ethylene and vinyl compounds under gamma irradiation, all the evidence points to chain reactions of high yields, although for many other monomers the mechanisms are not so clearly defined. In general for unsaturated hydrocarbons, the following four inter-action rules seem to apply:

(1). The ionizing radiation does not rupture multiple bonds;

(2). Multiple bonds inhibit the rupture of neighboring single bonds (the protective effect of triple bonds being greater than that of double bonds);

(3). The effect of a multiple bond is least when it is located at the end of a chain; and

(4). The cis form of a compound is less stable than the trans form.

Thus, we find that the yields of hydrogen and methane are less and the yields of polymeric products greater from unsaturated compounds than from their corresponding aliphatics (1),* and that polymer yields are higher for those compounds having a double bond at the end of the chain than for those with a like bond in other positions (2). Similarly, dienes can be expected to be relatively more prone to polymerization than compounds having only one such bond. This has been observed to be the case for both allene and isoprene (3).

On the other hand, to emphasize the fact that these rules can serve only as direction and not as absolute wisdom, and to point up the fact that there still is much to be learned about the fundamental process involved, the rate of gamma ray-initiated polymerization of butadiene is in an order of magnitude less than that for styrene under identical conditions (4).

Effects on Polymers

A wide variety of compounds have been polymerized using no catalyst other than radiation. Acetylene, methyl acetylene, ethylene, propylene, butene, cyclopentene, styrene, vinyl chloride, methyl methacrylate, vinyl acetate, and acrylonitrile are only a few of the more interesting monomers investigated.

In the case of vinyl polymers, it has been shown conclusively that polymerization proceeds via a free radical chain (5). The high G values (>1000) are indicative of a chain mechanism, since the average energy required to form a free radical with radiation has been determined experimentally to be in the order of 10-30 e.v. The free-radical nature of the reaction has been illustrated in many ways, just one being the inhibition of the reaction by oxygen and hydroquinone. It has been shown that the propagating specie is the monoradical.

*Numbers in parentheses refer to Bibliography at end of article.

Daniel H. Greenberg was born in New York, N. Y., in 1927. He received a B.S. from Yale University in 1948, an M.S. from the University of Chicago in 1949, and a Ph.D. from Columbia University in 1954 (all degrees were in Physical Chemistry). Following graduation, he held a post-doctorate appointment in Radiochemistry at the Department of Chemistry in Columbia University from 1954-1955. In 1955-1957, he was a research scientist in the Nuclear Physics Section, Armour Research Foundation. He joined U. S. Industrial Chemical Co. in 1958 in his current capacity of Project Leader in charge of Radiation Chemistry Research. His active professional memberships include A.C.S. and the American Physical Society. He also is a member of Phi Beta Kappa and Sigma Xi.

Dr. & Mrs. Greenberg have two children (both boys), and make their home in Pennington, N. J.

On the other hand, the acetylenic polymers have low molecular weights and low G values (6). In addition, for acetylene, the relatively high yield of benzene and other aromatics also produced suggests that an ionic reaction more probably is involved.

Only for ethylene does a real enigma exist. The irradiation of ethylene with alpha particles and electrons at room temperature and pressure produces a low molecular-weight, low yield, usually liquid polymer, and the evolution of considerable gaseous products (hydrogen, methane, etc.) (7). Irradiation with gamma rays gives all indications of a chain reaction resulting in high molecular weights (a waxy product) and high G values (8). Increasing the temperature increases the yields and the molecular weight, but increasing pressure seems to produce a more liquid product although yields also increase. G values greater than 10,000 have been reported.

While the difference between the products of the particle and gamma irradiation could be attributed to differences in radical concentrations in the systems, as perhaps also could be the pressure effect, the mechanism of the chain propagation under gamma irradiation is still unknown. Strong inhibition by oxygen has been reported (9). Others, however, claim that the presence of small amounts of air, water, carbon dioxide, acetone, or acetaldehyde have no effect on the reactions, thus placing considerable doubt as to the free-radical nature of the reaction.

Suffice to say that ethylene and vinyl compounds can be polymerized with nuclear radiation in good yield, even if the mechanism is not always well under-

stood. The disadvantage presently is economic. The advantages, however, are many and it is to be hoped that decreasing costs and improved technology will soon make irradiation-produced plastics an economic reality. The use of radiation means the elimination of catalysts and the subsequent steps of purification and cleaning.

Radiation means better control of molecular weight since contrary to thermal polymerization, molecular weight increases with temperature in the presence of a radiation field (7). The deep penetrating power of the radiation and the constancy of the radiation field mean more even reaction rates and more uniform products. The necessity of extreme temperatures and pressures is eliminated.

Polymerization of pure monomer in the liquid and solid state can be achieved without the need for additional solvents. For liquids, this has been accomplished with styrene, methyl methacrylate, acrylonitrile, vinyl chloride, and vinyl acetate. In the solid state, acrylamide, acrylic acid, and N-vinylcarbozole are a few of the monomers that have been polymerized with gamma rays at room temperature.

In addition, substances irradiated at very low temperatures have been observed to polymerize upon subsequent warming, apparently the result of the release of free radicals produced and trapped at the low temperature (10).

Some compounds which cannot be made to polymerize thermally have done so under irradiation; e.g., perfluoropropylene and perfluorobutadiene (11). While only short chain-length liquids have been obtained to date, it does serve to point the way towards new useful polymers that may yet be discovered.

The second major application of nuclear radiation to the plastics industry is the treatment of preformed polymers to improve or alter their physical properties. When irradiated in the absence of air, three competing effects occur: cross-linking; chain scission; and side-group degradation.

Generally, cross-linking will occur only when there is at least one hydrogen in the alpha position to the $-CH_2-$ group. Otherwise, degradation will be the main effect, with scission of side branches generally predominating over main-chain scission or dehydrogenation. For example, the main effect of irradiation on polyethylene, polymethylene, polystyrene, polyacrylic acid, and polyvinyl alkyl ethers is cross-linking; while polytetrafluorethylene, polyisobutylene, polymethacrylic acid, and polymethylstyrene suffer degradation.

The advantages of cross-linked vinyl polymers are well-known. In general, cross-linking raises the softening temperature, increases the chemical resistance, and improves the tensile strength of the polymer. With polyethylene, these attributes have been obtained with very little deleterious effect on other properties. Similarly, unvulcanized rubber can be cross-linked (12), although the only possible advantage over conventional thermal methods might be its application to very thick or unusually shaped items. Siloxanes also are cross-linked under irradiation (13).

Not much attention has been devoted to plastics and resins other than the vinyls, but the small amount of evidence indicates, as expected, that decomposition is the principal result with nylons, polyesters, phenolics, cellulosics, and aniline-formaldehyde polymers.

Considerable effort also has been devoted to the production of unique block and graft polymers. Of particular interest are the phenomena by which many polymers retain active sites for further polymerization over long periods of time after irradiation. Otherwise, the basic techniques for producing copolymers by irradiation are much the same as those utilizing conventional techniques, with the advantages that the conditions may be simpler and that the large energies involved often allow reactions to proceed that were previously unknown. For example, the surface grafting of styrene onto Teflon improves its adhesive properties. In general, radiation-produced copolymers and radiation-grafted polymers will be expected to have different properties from those obtained by thermal means.

Some typical polymerizations catalyzed by radiation are shown in Table 1. Table 2 shows the principal effects of radiation on some commercial resins, while Table 3 lists approximate radiation dosages required for some chemical reactions. Table 4 gives a comparison of irradiated and non-irradiated, high-density polyethylenes.

Conclusions

Although only small quantities of radiation cross-linked polyethylene are available commercially today

Table 1. Some Typical Polymerizations Catalyzed by Radiation.

Monomer	Nature of Monomer	Type of Radiation	Pressure, Atm.	Temperature, °C.	Nature of Polymer	G	Bibliography Reference
Ethane	Gas	Alpha	~ 1	25	Liquid to solid	~ 5	17
Ethylene	Gas	Alpha	~ 1	25	Liquid	14	7
		Gamma	21	Room temp.	White, waxy solid	2,500	9
			21	237	Liquid	12,000	9
			2,000	100	Solid	—	19
Perfluorobutadiene	Liquid	Gamma	1	30	Grease	—	11
Benzene	Liquid	Electron	1	Room temp.	Liquid	0.75	16
	Gas	Alpha	< 1	Room temp.	Liquid	4.1	15
Acrylamide	Solid	Gamma	1	35	Mol. wt. 48,000 at 13.8% conversion; gel formation at 50% conversion	~20,000	18

Table 2. Principal Effects of Radiation on Some Commercial Polymers.

	Cross-Linking	Chain Scission
Polyethylene	X	
Polystyrene	X	
Polyesters		X
Polyacrylic esters	X	
Cellulose		X
Nylon		X
Natural rubber	X	
Neoprene	X	
Phenolics		X
Casein		X
Melamines		X
Siloxanes	X	
Polytetrafluoroethylene		X
Polyvinyl chloride	X	
Polyvinyl alcohol	X	X

Table 3. Approximate Radiation Dosages Required to Produce Desirable Chemical Reactions.

	Roentgen Equivalent*
Halogenation of benzene	0.1
Grafting	0.5-5
Polymerization	0.2-5
Cross-linking	1-10
Vulcanization	10-50

*In megarep., that quantity of radiation that will deposit 93 ergs of energy in one gram of material.

Table 4. Properties of Irradiated and Non-irradiated High-Density Polyethylene (20).

	Phillips Type		Ziegler Type
	Non-Irradiated	Irradiated	Non-Irradiated
Density	0.961	0.945	0.945
Yield strength at 73° F., psi.	4,400	3,200	3,200
Ult. tensile strength at 73° F., psi.	2,500	4,200	—
Elongation at 73° F., %	80	500	100
Stress cracking, hrs.	2-3	>2,000	77-125
Heat cracking, hrs.	3	>2,000	264

(14), the variety and quantity of radiation-cured polymers and radiation-produced grafts for special purposes can be expected to increase rapidly in the near future. The economic use of nuclear sources to catalyze polymerization probably is in the more distant future.

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—THE END

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Development of Steam-Resistant Fiberglass-Reinforced Plastics

Report on a test program emphasizing the need for hydrolysis-resistant polyesters, exclusion of water from materials, synthetic fiber overlays, cure operations, and the quality of premix compound products.

THIS study was performed for the Military Medical Supply Agency of the Navy Department as part of a survey of the problem of replacing stainless alloys with plastics in a variety of hospital ware if military necessity should ever require such substitution to conserve the supply of certain metals. Similar metals substitution possibilities have been tried for the civilian hospital-ware market via the route of injection molded, premium-quality thermoplastics such as polyamides; polymers of chloromethyl oxetane; and possibly with the heat-resistant grades of polyethylene and polypropylene.

Although many theoretical reasons would favor the

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choice of thermosetting resins for this application, relatively little has been done in this field. Particularly with reference to fiberglass-reinforced polyester moldings, many engineers have taken it for granted that defects such as poor surface finish and inferior steam resistance are necessary and insurmountable limitations of the product. Here, we will show that adequate engineering of all important details can produce a product which satisfies very severe specifications via the polyester molding route. What is more interesting is that the problem can be solved utilizing materials and methods commercially available to most competent fabricators.

Products such as surgeons' wash basins, emesis basins, bed-pans, and miscellaneous hospital ware must satisfy durability specifications more severe than necessary for household kitchen ware. Hospital utensils must withstand repeated autoclaving (steam at 20 psi, and 259° F.), repeated washing with hot solutions of detergent or with oxidizing antiseptic solutions, cleaning with abrasives, and exposure to staining medicinals. Moreover, the surface must show no fiber pattern, roughness, cracking, tackiness, bloom, or any features of texture which make inspection for cleanliness difficult. A limited color drift during prolonged service can be tolerated, but service use should not cause noticeable shrinkage or distortion. The ideal plastic should approach stainless alloys in chemical inertness and stability of strength and appearance.

Material Selection

A preliminary screening showed that steam resistance might be expected from some resins in the plastics materials classes of epoxy, phenolic, melamine, allyl ester, and styrene-unsaturated polyester copolymers.

To obtain moldings of high strength and good decorative properties, these resins must be admixed with decorative pigments, reinforcing fillers and, possibly, inert extenders. Of all the possible resin groups, the styrene-polyester class seemed to present fewer problems of either compounding or fabrication; hence, the first phase of product development was directed to trying resins of this class. This decision was influenced markedly by the fact that styrenated polyesters are inexpensive, and production experience and facilities for handling them are more extensive and competitive.

The first screening through the steam resistance test showed disappointing results, although they were not entirely unexpected. Nearly all resins of the polyester family lacked steam resistance. During this initial period more than 30 polyester resins, representing several different types, were screened in both laboratory and pilot molding experiments.

For this preliminary screening program, molded specimens were prepared from each of the resins tested, using preforms made of chopped, two-inch, 60-end, Garan-finished fiberglass roving. Slabs of cured specimens were exposed to 20 psi. saturated steam (259° F.) for 24 hours. Samples were examined after four, eight, 16, and 24 hours of exposure. With the exception of four or five resins, severe degradation of the molded specimen was observed after only 1-5 hours of exposure. Appearance of the exposed samples which failed could be described as (1). decreased translucency or increased opacity; (2). darkening of color, usually to tan or brown; (3). severe crazing and/or cracking of the surface; and (4). considerable amount of tacky resinous exudation.

Of the many commercial resins tested, only five of the best, which retained some integrity after 24 hours of exposure, are noted in Table 1. Of these five, Atlac 382E seemed to be the most promising. Laminac 4109 might be useful if variations of curing conditions could be found that eliminate the tendency for minor surface crazing or cracking during steam exposure. The others are listed only because they suggest some hope that resins of these types might be upgraded further to the steam-resistant class.

The compositions of the more steam-resistant resins are not disclosed in the manufacturers' specifications. Our attempts at synthesis of steam resistant polyesters showed that only minor improvements of non-resistant resins could be obtained by varying the composition and types of aliphatic glycols or of either the aromatic or unsaturated ethylenic dibasic acids. Greatest benefits were derived from substituting another glycol type for all or part of the aliphatic glycols.

Variables Affecting Steam Resistance

A hydrolysis-resistant resin is essential for obtaining steam resistance. However, even with a suitable resin, other variables can adversely affect steam resistance in the final molding. Some possible variables are:

(1). Type of fiberglass finish or treatment;
(2). Type of binder resin in preform;
(3). Surface finish and overlays; and

Table 1. Effect of Steam on Polyester-Fiberglass Basins.

Suppliers	Molding Resins	Appearance after 24 hrs. Exposure
Atlas Powder Co.	Atlac 382E	Decrease in translucency; no other visible change.
American Cyanamid Co.	Laminac 4109 and 4107	Decrease in translucency; noticeable change in color; very minor crazing or cracking of surface.
H. H. Robertson Co.	Stypol-25	Decrease in translucency and gloss; color change; small cracks over entire surface.
Durez Plastics Div., Hooker Chemical Corp.	Hetron 92A	Considerable darkening accompanied by a spotty exudation of a dark brown tacky resin; little or no crazing of surface.
Durez Plastics Div., Hooker Chemical Corp.	Hetron 93LS	Similar to Hetron 92A, without the spotty exudation; surface slightly tacky; considerable cracking of the underside of basin.

Table 2. Tests of Paraplex P-43* Laboratory Laminate Specimens.

Finish	Flexural Strength, Psi.		Appearance of Laminate Specimens	
	Initial	Final	Before Steaming	After 24-Hr. Steaming
2,4,6-trimethylol phenylallyl ether + VTS**	64,000	30,000	Good surface; translucent	Discoloration; slight delamination; opaque; rough, tacky surface; exudation.
Untreated	42,000	17,000	Dry spots on surface; translucent	Delamination; opaque; surface warped; contains large bubbles; exudation.
Untreated	44,000	19,000	Dry spots on surface; translucent	Delamination; white; opaque; surface warped, rough.
Methacrylate chromic chloride	66,000	19,000	Surface smooth; translucent; small bubbles beneath surface	Discoloration; opaque; surface rough; exudation.
Cross-linked polybutadiene + VTS**	59,000	27,000	Surface smooth; translucent; small bubbles beneath one surface	Discoloration; opaque; delamination; exudation.
Tolylene diisocyanate + VTS**	65,000	23,000	Good surface; translucent	Discoloration; opaque; bubbles; exudation.
Hydrolyzed VTES#	54,000	23,000	Good surface; translucent	Opaque; bubbles; exudation.
Polyvinyl siloxane	53,000	16,000	Dry spots on surface; translucent	Delamination; surface rough; slight discoloration; exudation.

*Product of Rohm & Haas Co., Philadelphia, Pa.
**Vinyl trichlorosilane.
#Vinyl triethoxysilane.

(4). Type of pigmentation or coloration.

To eliminate the possibility that the finish or treatment on glass fibers was largely responsible for the failure of so many resins in steam exposure, laminates were prepared from heat-cleaned glass cloth on which a variety of surface finishes were applied. The molding resin used was Paraplex P-43*, which had failed in the screening tests previously discussed. The results in Table 2 show that poor steam resistance of the resin, rather than type of glass finish, was the cause of failure of the systems in the original screening tests.

Similar experiments were performed using Atlac 382E** resin. The exposure tests again demonstrated the superiority of this resin, since none of the laminates failed as severely as those described in Table 2. Although the type of finish on the glass proved to be a secondary factor when a hydrolysis-resistant resin is used, differences in appearance of the exposed laminates were noted over different glass finishes. Opacity changes or the appearance of tacky exudation products resulted when unsuitable glass finishes were used, even with hydrolysis-resistant polyester resins. The commercial finishes based on vinyl trichlorosilane were most satisfactory, and use of such was standardized in other experiments.

No detailed study was made regarding the utility of the many commercially available resins which are recommended as binders for preforms. The two evaluated most extensively were Glidpol 1007# and a formulation based on Atlac 382E. Results obtained with Glidpol 1007 showed the importance of baking the preform thoroughly. When the preforms were baked for five minutes at 400-420° F., the resulting basins molded therefrom passed the steam-exposure test. When preforms were baked at temperatures below 350° F., the moldings showed resinous exudations and minor blisters after steaming. Atlac 382E proved satisfactory as a binder resin when cured at temperatures from 350-420° F.

*Made by Rohm & Haas Co., Philadelphia, Pa.
**Made by Atlas Powder Co., Wilmington, Del.
#Made by The Glidden Co., Cleveland, Ohio.

CLAYS. Clays are used commonly as diluent fillers. Some of the "water-resistant" clays might be used with some minor sacrifice of steam resistance. In general, clay filling aggravates the tendency toward blistering and delamination during steam exposure. This tendency can be mitigated by thorough curing of the laminate. Usually, it proved safer to avoid the use of diluent fillers. Different lots varied in the degree to which they aggravated blistering, and all those used in the experiments showed some tendency to degrade the water resistance of laminates. On the other hand, the damaging effect of inert fillers was not as great as anticipated, and further experimentation might demonstrate that some can be used without reservation, particularly in the premix technique using the molding compound which will be described later.

RESIN IMPREGNATION. Initial molding experiments and steam exposure tests demonstrated the necessity for accomplishing complete resin impregnation and thorough wetting of the glass fibers. Complete suppression of glass fibers from the surface of the molding was desirable, since fiber pattern was aggravated by steaming.

MOLDING FINISH. A study was made of the molding conditions that could produce utensils having a resin-rich, fiber-free surface. The surface texture desired was such as could be produced using a gel coat of 1-2 mils thickness. This objective was never fully realized, and two alternative solutions were proposed, as follows:

(1). The use of Dacron, Orlon, Dynel, and Modigliani overlays to suppress the pattern caused

by the chopped glass rovings of the preform;

(2). Painting the molded product with a steam-resistant coating.

Of the four overlays tested, Dacron proved to be the most satisfactory in preventing fiber raising during steam exposure, while Dynel and Modigliani overlays were unsuitable. Dynel surfaces showed a marked degradation, and Modigliani veils caused a noticeable bloom to form during steaming. The difference between Orlon and Dacron was marginal.

In the painting method, the coating was applied by spray to molded basins and baked according to the schedule recommended by the suppliers. The painted basins were exposed to 20-psi. saturated steam for 24 hours. The results of these tests are shown in Table 3. Apart from the practicality of painting to obtain a good surface finish, these results show something about the status of the art of formulating coatings for polyester products.

The screening tests listed in Table 3 were most encouraging. The coatings numbered 4, 5, 12, or 15, either alone or in combination with the coating No. 2 as a primer, all withstood 24 hours of steam exposure satisfactorily. The use of the primer coat would be justified only if the fiber pattern of the molded utensil was quite pronounced and needed filling before painting. Frequently this is the case. Obtaining a steam-resistant surface finish by painting a molded product is a technical possibility if the same effect cannot be obtained directly in the molding operation.

Attempts to develop a surface finish equivalent to that obtained with painting by using a "gel coat" technique during molding were disappointing, largely because adhesion adequate to withstand steaming could not be obtained with the several commercial "gel-coats" tried. However, some of the paints that showed promise closely resemble the better "gel-coat" formulas in compositions (most of which contain epoxy resins). This suggests that experimental work is necessary on the "gel-coat" process before this possibility can be discarded as an alternative means of producing a smooth, bright surface finish. Gel coats, if developed to a more advanced adhesive level, would minimize the major difficulty of applying the baking types of spray paints. The operation of baking the paint can result in a blistered paint film if residual volatiles in the molding are not reduced to a low level before painting.

PIGMENTS. The steam and heat resistance of the pigments used to opacify and color-shade the molded product must be watched carefully. Most pigment

Table 3. Effect of Steam on Coated Basins.

No.	Supplier	Coating Description	Appearance after Exposure to Steam at 25-Psi. (267° F.)
1.	Case Inst. laboratory	50% Atlac 382E in styrene + 1.5% benzoyl peroxide (30 min. at 100° F.; 30 min. at 260° F.)	Surface covered with craters after 2¼ hours
2.	The Glidden Co.	Glidden primer 6070 (30 min. at 275° F.)	Slight discoloration after 24 hours; no other visible effect; excellent adhesion
3.	"	Prime coat same as No. 2; top coat same as No. 1	Surface covered with craters after 2¼ hours
4.	The Arco Co.	Top coat LS-10084 over primer 123-41149; each coat baked 30 mins. at 325° F.	No gloss at four hrs., small blisters at eight hrs., discoloration at 24 hrs.; fair adhesion
5.	Co-Polymer Chemicals	Epoxyn AW-50 (20 min. at 300° F.)	Fiber pattern shows through; slight cracking of film; little or no color change; excellent adhesion —24 hrs.
6.	"	Epoxyn RW (baked 40 min. at 350° F.)	Slight color change, no other visible change; excellent adhesion—24 hrs.
7.	"	Prime coat same as No. 2, top coat same as No. 5	Little or no color change, no other visible change; excellent adhesion—24 hrs.
8.	Case Inst. laboratory	Epon 828—Vinylite VAGH, lacquer (baked 30 min. at 300° F.)	No adhesion, film peeled away from basin
9.	The Glidden Co.	Glidden primer 6070 (30 min. at 400° F.) top coat same as No. 5	Slight change in color, no other visible change; excellent adhesion
10.	"	Glidden primer 6070 (baked 30 min. at 400° F.); top coat 1:1 Atlac-styrene + 1.5% benzoyl peroxide (30 min. at 100° F., 30 min. at 260° F.)	Decrease in gloss; pinholes and craters over entire surface
11.	"	Glidden primer 6070, baked 30 min. at 400° F.; Parr paint D-183 (30 min. at 300° F.)	No visible change in surface; excellent adhesion
12.	Co-Polymer Chemicals	Epoxyn AW-50, 10 min. at 300° F.	Little or no change in color, no other visible change; excellent adhesion
13.	Case Inst. laboratory	50% Atlac 382E in styrene + 1.5% benzoyl peroxide (30 min. at 100° F., 30 min. at 260° F.)	Coating softened and ran, leaving sections of the basin dry or exposed
14.	The Arco Co.	Arco LS40489 (30 min. at 400° F.)	Slight color change, decrease in gloss; excellent adhesion retention after 24 hrs.
15.	Parr Paint Co.	D-183 Parr Paint (30 min. at 300° F.)	Fiber pattern becomes more prominent; adhesion good; coating brittle after 24 hrs.

paste dispersions supplied for general-purpose color blending with polyesters contain either pigments or other ingredients which can ruin the steam resistance of the molded product. To obtain the standard Medical Green color of moldings, a steam-resistant pigment-paste formula was developed. Alternative formulas exist for the same color; for example, an even more steam-resistant paste could be devised using chromium hydrate pigments instead of phthalocyanines. Phthalocyanines are prone to give a "color float" under some molding conditions.

Relatively few commercial pigments are steam-resistant, but there are enough steam-resistant types to allow for matching most desired colors. Not all resistant colors are easy to compound into a tinting paste, and these may yield less storage-stable pastes than can be obtained with less durable pigments that yield equivalent colors.

The pigment paste formula used in our tests utilizes the same vehicle used for the molding resin. This is not essential provided the alternative vehicle is steam-resistant and compatible with the molding resins. Other vehicles for the paste may give a more storage-stable product.

Molding Technique

The following describes the molding conditions for production of surgeons' wash basins. Most of the information is equally relevant to other hospital items, such as instrument trays and bed-pans.

Tooling

The punch and cavity were machined from billets of 1040-50 carbon steel. The clearance of "pinch trim" originally was 0.002-0.004 inch, and later was increased to 0.015-0.020 inch to accommodate the ¼-ounce Dacron overlays. The mold was equipped with a ¾-inch blow-off button that later was found to be of considerable advantage in removing "experimental basins" from the force half of the die when mold-sticking occurred. The mold, as originally received, was of steel and polished to a 320-finish. After experiencing considerable trouble in obtaining consistent release of cured pieces from the mold, both halves of the mold were "flash chromed" and polished. This largely solved the mold release problem. The mold was transfer-heated by clamping directly to steam-heated platens. The finished male mold clamped to the press steam platen is shown in Figure 1.

The preform screen was precision fabricated so that its profile was the same as the male mold to within ±1/64-inch. The fabricated screen was attached to an adapter plate or base to facilitate insertion and removal from the suction chamber of the preform machine or the preform curing oven.

Preforming

The preform screen was installed in an open-type flocking machine. Preforms were made by discharging 2-2½ inch cut roving from the Brenner Cutter to the preform screen. Part of the resin binder was sprayed onto the glass preform during its formation, and the remainder was sprayed on immediately after

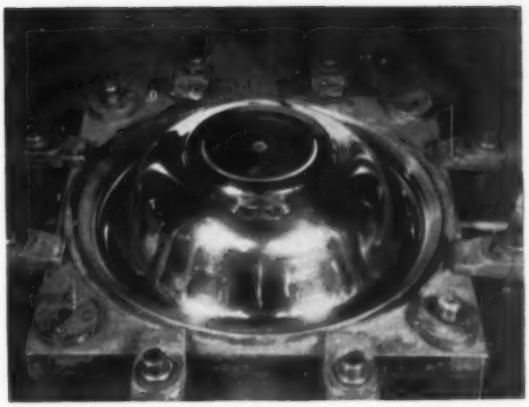

Fig. 1. Male half of mold for surgeon's basin bolted to steam platen—ready for molding.

the necessary amount of glass fiber had been blown. Efforts were made to use only the minimum quantity of binder required to give mechanical stability to the preform. This varied from piece to piece.

The freshly prepared preform along the preform screen was removed from the suction chamber of the preformer and placed in a curing oven. Here, hot air was forced through the glass preform at 400-420° F. for five minutes. A properly-cured preform developed a faint straw coloration. A visual inspection of the preform revealed gross variations in glass fiber density. Figure 2 shows a trimmed, finished fiberglass preform ready for molding.

Molding and Finishing

A circular piece of 1/4-ounce Dacron mat was placed in a supporting basin. The Dacron was stretched and adjusted to minimize wrinkles, and placed atop the fiberglass preform. A second basin was pressed against the preform to shape the Dacron to the contour of the basin. After this pressing basin had been removed, a weighed amount of resin was poured into the concave side of the preform and the second layer of 1/4-ounce Dacron was pressed into place in the same manner. The entire contents of the support basin were inverted over the male mold (see Figure 3).

Because this recipe has a gel time of about 45-50 seconds at 240° F., the "slow squeeze" time of the press was adjusted to 30-40 seconds and the "slow

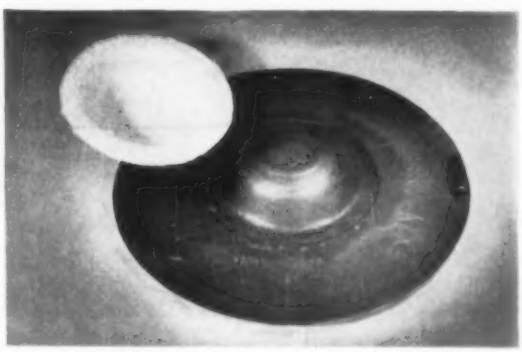

Fig. 2. Preform screen and finished preform for surgeon's basin.

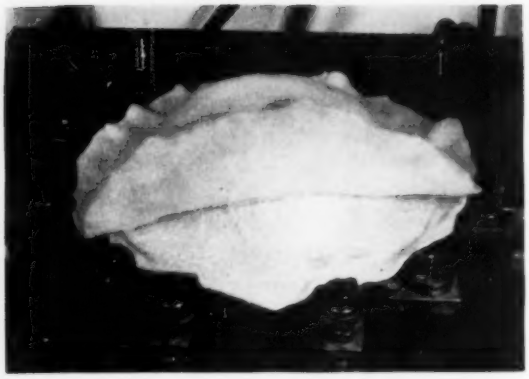

Fig. 3. Resin-loaded preform-Dacron composite fitted to male mold immediately before closing molding press.

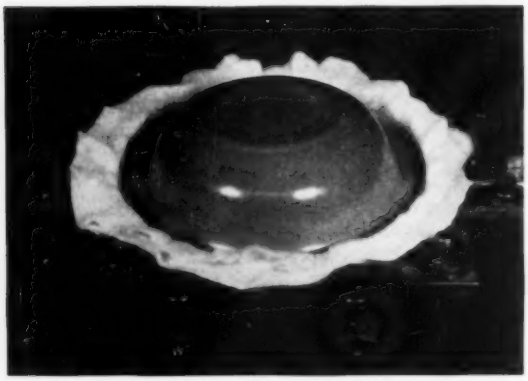

Fig. 4. Fully-cured basin as it appears when first opening hot mold.

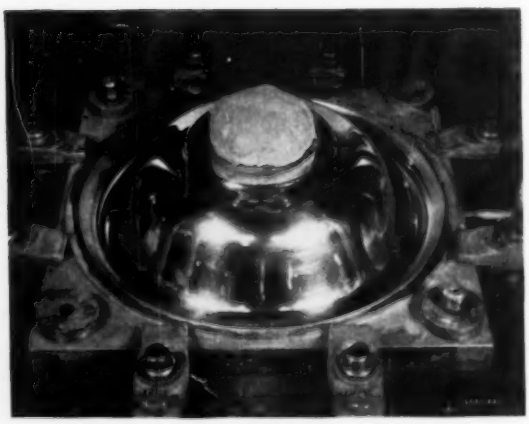

Fig. 5. Die (see Figure 1) with premix compound in place just before molding.

squeeze" distance to about ¾-1 inch. In different molding shops, these conditions may vary slightly to accommodate variations in pot life and viscosity of the resin formulations, the wet-ability of the preform and Dacron, the flow characteristics on the mold, and the special characteristics of different presses.

After five minutes at 240° F., the mold was opened and the piece removed by forcing compressed air through the blow-off button, as shown in Figure 4. The resin flash and excess Dacron-preform were trimmed and the sharp edge remaining was removed.

Inspection

All finished basins were inspected for color uniformity, smoothness, gloss, appearance of resin-starved areas, blisters, and pinholes. If no gross flaws or imperfections were found, a few representative samples were placed in a steam autoclave for 24 hours at 259° F. The steamed basin again was inspected for blisters, color drift, crazing, and warpage.

Experience gained during the development of these utensils has shown the following to be the most common causes of failure to produce specification items:

(1). Preform is too heavy.
(2). Preform resin-binder not properly cured.
(3). Pigment paste not completely dispersed.
(4). "Slow squeeze" of press not properly adjusted or controlled.
(5). Air entrapment in freshly-prepared resin mix.

The impact resistance of glass-reinforced moldings of this type is excellent. For example, a basin filled with water can sustain a dead drop onto concrete from a height of 4-6 feet without suffering damage other than minor surface crazing. The strength is adequate to withstand considerable rough handling in ordinary use. If the molding resin is cured sufficiently to develop 24 hours of steam resistance, it also is cured sufficiently to develop optimum toughness. Dangers of over-curing are minor at less than 260° F. The 24-hour steam test indicates a great deal regarding whether the molding is cured to optimum properties.

Premix Molding

The molding technique described in the foregoing section produces a product of premium grade with respect to appearance and strength. If some sacrifice of impact strength can be tolerated, a simple technique using a satisfactory molding compound can produce items of excellent appearance that equal the

Table 4. Molding Compound Recipe

Atlac 382E	60 parts
Styrene	40
Benzoyl Peroxide	1
Pigment Dispersion	2
Cure: Five minutes at 240° F.	

*Now part of Atlas Powder Co., Wilmington, Del.

(Continued on page 48)

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Extrusion Theory—Part II

The conclusion of a two-part article showing that a sound theoretical understanding of extruder operation can be of great value in obtaining optimum results in actual machine performance.

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Cross-Channel Flow

Returning to the picture of cross-channel flow (as shown in Figure 5), we realize that this is an instantaneous view showing the directions and velocities of each portion of the material. Now, however, we will look further along the actual paths followed by a few molecules. Figure 6 illustrates a longer portion of cross-channel flow, and we will assume that the bars are moving across from right to left. As the bar approaches molecule "X" near the surface of the plate, the molecule is forced to move. Its most difficult path would be to move along the surface of the plate, pushing ahead of it all the molecules sticking to the plate, so it takes the easier path of moving down into the center of the channel. In so doing, it joins the other molecules that are streaming along in the path of least resistance at the maximum distance form both stationary plates, and moves at a speed greater than the speed of the bars until it has crossed to the other side of the channel where it must slow down. At this point, it is crowded by the fast-moving particles behind it and rises to the stationary surface, again filling the void that continually is being left by the retreating rear face of the flight.

Thus, the forward movement is in a path something like a cycloid; resting against the surface at each peak until the advancing flight comes up to it, and then moving down into the channel and racing across to arrive again at a point of momentary rest. As molecule "X" starts across the channel it and the other fast-moving molecules exert a drag on such a particle as "Z" that is an intermediate distance between the stationary plate and the center of the channel, pulling it along at a lower speed. Particle "Z" will have changes in speed, but not such great changes as particle "X" since the only particles that stop moving are those which touch the stationary surfaces; those that move

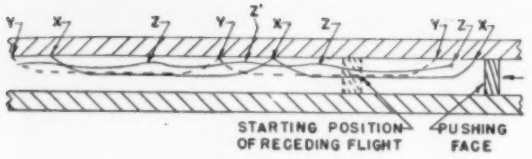

Fig. 6. Longer portion of cross-channel flow representation in extrusion shown in schematic drawing.

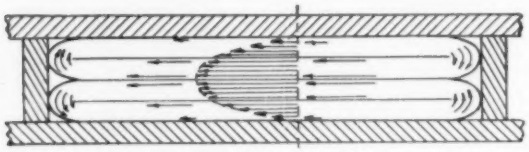

Fig. 7. Cumulative schematic drawing representing cross-channel flow in extrusion flow.

most rapidly are the ones in the center of the channel.

As molecule "X" passes molecule "Z" and rises to the surface molecule, "Z" slows down somewhat, but the next screw flight now starts to approach. New molecules start to push "Z" forward, but it does not go so deep nor so fast now. It hesitates again at "Z" as molecule "Y" passes and rises to the surface. Molecule "X" then again moves and pushes "Z" onward with a continuous series of cycloidal and muted cycloidal paths. Some particles evenly spaced between the stationary surfaces and the high-speed center stream possibly travel at a uniform speed as long as they stay in the same part of the stream with the other molecules flowing around them. Thus, the flow is like a pressed-down tire rolling along between two plates, but cohering in the center and flowing on itself as it rolls along. This is illustrated in Figure 7.

Cross-Channel vs Along-The-Channel Flow

Simultaneously with the across-channel flow, along-the-channel flow also is occurring. Figure 8 shows our

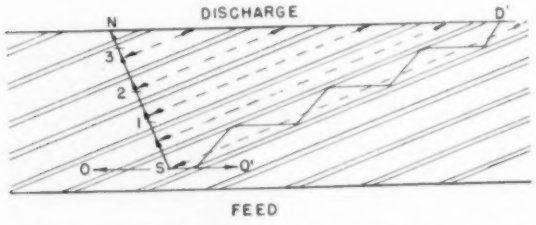

Fig. 8. Cross-sectional representation of flow action by "flattened-out" extruder.

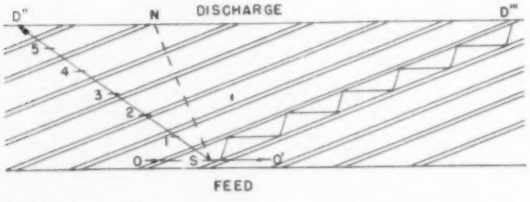

Fig. 9. Representation of modified flow path by extruder having a resistance in its discharge path.

flattened-out extruder, extended a considerable distance sideways. Assuming that a particle "S" is being observed and that this particle is a short distance into the extruder, it will follow two seemingly different courses of action depending upon which elements we consider stationary and which moving. Let us consider that both plates are stationary and our eye remains stationary with them while the bars only move at right angles to their face in the direction "S" to "N". Particle "S" will follow directly along the line S-N with a cross-channel flow pattern, as illustrated in Figures 5, 6, and 7. Assuming that the bars continually appear at the feed line and move on until they disappear at the discharge line, the particle "S" finally will reach the discharge with no apparent flow along the channel, since it always moves at right angles to the flight face and not to either side of this line. However, since we are assuming that the bars disappear when they reach the discharge line, the distance from particle "S" along the channel to the discharge line continually grows less because the length of the channel in that direction decreases.

If we picture the bars only as moving from "S" to "O", the effect still is almost the same, except that the frictional drag of the sides of the flights will deflect line S-N slightly to the left. If we ignore the frictional drag of the sides of the flight, the particle will flow directly along line S-N. We see in this case that the material does not flow along the channel but, on the contrary, the channel slides past the particle which inevitably pursues its path from "S" to "N" regardless of the direction in which the bars move. This is true so long as the bars move up to occupy the former position of a bar closer to the discharge. When viewed from this position, therefore, the along-the-channel flow seems of minor importance, more apparent than real.

Referring to Figures 5 and 6, we see that the particle will rise against the surface as at "X" and will remain stationary against the surface, until the bar or flight catches up to it and drives it on again. These points of rest are shown at 1, 2, and 3 in Figure 8. As the particle starts to move from S, driven by the bar, it moves more rapidly than the bar until it rises and remains stationary at 1. The bar then catches up to it and the cycle is repeated (the particle rushes rapidly ahead, then stops, and so on until discharge).

If, on the contrary, we picture the relative motion of the parts such that the bars are stationary and our eye remains stationary with them (as though we rotated around the extruder barrel keeping our eyes above a given spot on the screw) while the top and bottom plates move from "S" to "O′ ", we now have a system quantitatively equal to the previous one but looking quite different. The particle now must find its way from "S" along the channel to "D′ ", and the along-the-channel component is the one that seems important while the across-the-channel motion seems unimportant. The internal flow pattern of the viscous liquid will be identical in both cases.

Again returning to Figure 8, if we picture the plates moving in the direction S-O′, the particle will follow the zig-zag path from "S" to "D′ ". At the points 1, 2, and 3, the particle will be touching the plate and move

with the plate in the direction S-O′. When the particle moves against the bar, it will move downward and follow the slanted cross-channel path to the rear side of the opposite bar. At that point, it will rise to the surface of the moving plate and repeat the cycle. If a line S-N were drawn on the surface of the plate before the bars started to move in the direction S-O, the particle always would be directly under this line (S-N), although at varying depths from the time it started until it seemed at the discharge. Conversely, if the zig-zag line S-D′ were drawn in the channel space before the plates started to move in the direction S-O′, the particle would follow the zig-zag line down the channel while pursuing the line S-N relative to the plates. Thus, as the lines S-N and zig-zag S-D′ moved past each other, the particle always would be at their point of intersection.

Thus, along-the-channel flow and across-the-channel flow are inseparably intertwined, and are two aspects of the same thing. They can be separated only temporarily for analytical purposes. The particle traces the line S-N along the surface of the plate (the bore of the extruder barrel) and, at the same time, traces the line S-D′ down the channel.

If a resistance is offered at the discharge and the forward rate of flow reduced, the path will be modified as shown in Figure 9. The flow from "S" to "D′′′" is deflected from the normal line S-N, and the material takes a longer path. The line S-D′′ represents the line of flow in relation to the stationary plates when the bars only are moving with rest points as indicated at 1, 2, 3, 4, and 5. If, on the contrary, we picture the plates only as moving, the particle will follow the zig-zag path down the channel from "S" to "D′′′′".

The zig-zag lines S-D′ and S-D′′′ are exaggerated, as though a particle moved at full speed and then instantaneously came to rest against the surface of a plate. In fact, no particle would follow such a path. It would accelerate and decelerate gradually, and most particles would never come into contact with the metal surfaces. Instead of the sharp zig-zag shown for line S″-D′, the line would be wavy without touching the surfaces and rest points 1, 2, and 3 would be areas of reduced velocity rather than points of rest, and would occur more frequently. Of the numerous particles that would be under line S-N near the start at the vicinity of "S", there would be various depths and points along the line represented. Each of these points would follow a different wavy path from "S" to "D′", but all of these particles would travel directly under line S-N and each always would be at the coincidence of S-N and its own wavy line S-D′ in this idealized mechanism where the frictional effects of the sides of the bars (flights) are ignored.

In the case of the restricted flow shown in Figure 9, there also would be a variety of wavy lines from "S" to D′′′′" and line S-D′′ in this case would represent simply the average path. The actual paths would fan out on either side of line S-D′′ and these lines would also become wavy. Of course, the wavy lines from "S" to "D′′′′" would represent different average speeds of travel, such that particles starting from "S" at the same time would arrive at "D′′′′" at different times. The particles that moved most rapidly along the channel would trace a line on the plate to the right of line S-D′′, while the slower-moving particles would trace a line to the left of S-D′′.

The cross-channel flow components seem small in relation to the along-the-channel flow components, but it must be remembered that the distance to the discharge in the across-channel direction also is small in the same proportion. It may seem impossible for material to flow from the feed hopper to the die by across-channel flow, since the next flight is blocking the flow only a short distance away. The "next" flight is continuously moving out of the way, however, and the across-channel path to the discharge is just as open and unobstructed as the path along-the-channel.

Other Possible Motions of Elements

It is obvious that many motions of the three elements are possible other than the ones reviewed before. Those discussed above are the type of motions that exist in an extruder, but we can glance at some others.

For a first example, let us refer to Figure 2 and imagine the bars stationary with one plate moving in the direction S-B while the other plate moves in the direction S-C at the same speed. The material, of course, will be pulled along by both plates but equally

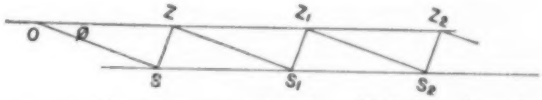

Fig. 10. Enlarged representation of modified flow shown in Figure 9 for extruder with a discharge resistance.

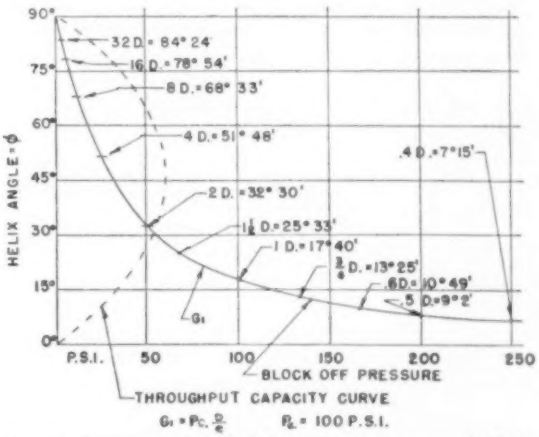

Fig. 11. Pressure-generating ability of extruder screw at block-off and open-discharge capacity is shown to vary with helix angle of screw.

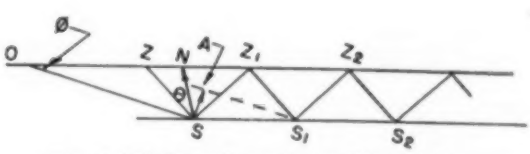

Fig. 12. Calculating flow under partial restriction.

in opposite directions, so that no over-all motion of the average mass of the material will occur. The average motion will remain zero. If the plate moving from "S" to "C" should slow up, a total motion of the material will start to occur because the total drag in the direction S-B will become greater than the total drag in the direction S-C. The slower the speed of the plate in the direction S-C, the greater the speed of the material in the direction S-B with the plate that continues to move in that direction. When the plate has stopped moving the direction S-C, the material will move in the direction S-B at one-half the speed of the plate moving in that direction minus the drag from the sides of the stationary bars. If the second plate also starts to move in the direction S-B, the speed of the material in that direction will increase until it will equal the speed of the two plates when both are travelling at the same rate in the direction S-B minus the drag from the sides of the stationary bars.

Keeping to a similar example, we will change slightly the direction of motion of the plates so that one moves in the direction S-O while the other moves in the direction S-O' at the same speed. The material now will circulate along a zig-zag path such as S-D' in Figure 8. However, the material in the upper and lower portions of the channel will move in opposite directions along the channel, each quantitatively balancing the other, and the average flow of the total mass will be zero in any direction. If the speed of the plate moving in the direction S-O is reduced, a positive flow in the direction S-D' (see Figure 8) will commence. As the speed of the plate moving from "S" to "O" is reduced to zero, a flow will occur identical to that discussed earlier under "Conventional Screw Action".

If the second plate should start to move in the direction S-O', the flow of the material toward the discharge will increase until such a time as both plates are moving at the same speed in the direction S-O'. A flow will occur identical to that discussed earlier under "Where Flight Only Moves".

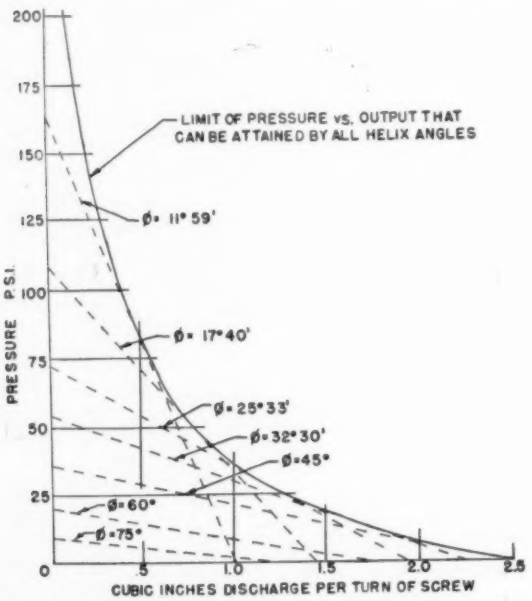

Fig. 13. Relation of pressure-generating ability of an extruder screw to volume out-put.

Pressure-Drop Flow

In Figure 5 where the bars only are moving between the two plates, it is clear that there is a pressure-drop through the material in the direction S-N, with a high pressure against the flight face that is pushing the material and a low pressure at the opposite side of the channel against the rear of the next flight. The amount of this pressure-drop will depend up on the viscosity characteristics of the material, the speed of the flight, and the channel shape. In Figure 3 where the bars and one plate are moving in relation to the other plate, there also is a pressure-drop in the direction S-N although to a smaller degree than in the construction shown in Figure 5 because of the smaller drag to be overcome.

This pressure-drop across the channel seems to hold the key to the answers to the following two important questions about extruders:

(1). Why does a liquid that is expected to flow from a high-pressure area to a low-pressure are continually enter the low-pressure hopper area of an extruder and flow toward the high-pressure discharge?

(2). What is the mechanism that connects higher-pressure-generation is an extruder with lower rate?

Referring to Figure 2, we will assume that the bars are moving in the direction S-N with both plates stationary. The material will flow across the channel in the direction S-N, generating a flow pattern as shown in Figure 5. If there is no resistance to the discharge of the material (open discharge), then the same pressure-drop condition will exist across all the channels at right angles to the direction of the flow and at all points throughout their length. If, for example, under a given set of conditions this pressure-drop is 100 psi., then the pushing face of the flight must generate 100 psi. at all points along the face to push the material across the channel width.

Block-Off & Pressure Build-Up

If a resistance is offered at the discharge, the output is reduced and the direction of the average flow across-the-channel is deflected away from S-N toward S-O. When the cross-channel flow thus is deflected, the distance it must flow across the channel is increased (the distance S-N, of course, is the shortest distance across the channel). As the material pursues this deflected path, the pressure-drop in the channel will increase and the pressure generated on the material by the pushing flight also will increase.

This pressure-drop will increase in proportion to the increased distance through which the material must be pushed across the channel and the increased speed at which it must travel. The greater the resistance at the discharge, the greater the deflection of the flow path and the larger the pressure-drop across the channel. At block-off, the material flows circumferentially from "S" to "O" and the largest possible pressure-drop is realized. (Actually, if material were forced into the machine through the die, the deflection would be greater and the distance of flow across the channel

would be even greater and the pressures still higher.)

Assume that the flight only is moving and we have a system that requires the pushing face of the flight to generate a 100-psi. pressure differential across the channel to move the material at the required speed. If the screw flight has a spacing of one diameter between flights in the direction S-N, then the circumferential distance S-O is twice the diameter. (This is a slightly different lead than the conventional one-diameter lead that is measured in an axial direction.)

When the material is forced from "S" to "O", it flows through a chanel 3.14 times longer than the normal flow from "S" to "N", but still must complete a cycle of flow in the same time as before since the screw is turning at the same speed. Thus, the pressure-drop from "S" to "O" will be increased over the pressure-drop from "S" to "N" by the product of these two factors: (1). Increase in cross-channel flow length by 3.14; and (2). Increase in speed of travel also by 3.14 times.

Since the material is flowing from "S" to "O" and the direction of flow in all parts of the channel is parallel to S-O, we can erect line S-Z perpendicular to S-O (see Figure 10). With this we know that all of the material is flowing perpendicular to line S-Z and, therefore, there is no component of flow in either direction along line S-Z. Since the liquid material is flowing by pressure-drop and there is no flow along line S-Z, we can assume that there is no pressure change along line S-Z.

Therefore, if we have a pressure-drop of 500 psi. from "S" to "O" giving us zero pressure at "O" and 500 psi. at "S", we also will have 500 psi. at "Z" since there is no pressure change along line S-Z. If there is a pressure of 500 psi. at "Z", then there is a pressure of 1,000 psi. at "S_1" since the pressure-drop in this direction for this distance is 500 psi. in all parts of the channel. There will be a pressure of 1,000 psi. at "Z_1" and a pressure of 1,500 psi. at "S_2" and "Z_2", and so on to the end of the screw.

From open discharge through increasing resistance to block-off, we find therefore, that the following three factors will increase, together with a constant-viscosity material:

(1). Drop in through-put rate;
(2). Deflection of cross-flow path; and
(3). Pressure rise from feed to discharge.

Thus knowing the cross-flow pressure-drop or the circumferential pressure-drop, the helix angle, and the length of the screw, the pressure-generating ability of the screw can be determined.

With changes in helix angle, we find that there is a considerable change in the pressure-generating ability of the screw. A worm of very long lead would have a longer line S-Z than shown in Figure 10. Thus, a much greater length of screw is needed for each increment of 500 psi. pressure rise in this worm. Conversely, where a screw of short land is diagrammed, only a short length of screw is needed to generate each increment of 500 psi. pressure rise. We conclude from this that, under block-off conditions, a group of screws having different helix angles but with the same circumferential pressure-drop, will develop the same discharge pressure if they all have the same number of turns of the helix.

The pressure-generating capacity of a screw approaches infinity as the lead approaches zero but, unfortunately, the through-put capacity of the screw also approaches zero. The pressure-generating ability approaches zero as the land approaches an axial line, and the forwarding capacity also approaches zero. Thus, the material-forwarding ability with open-discharge starts from zero at zero lead; increases to a maximum with a 45° helix; and again recedes to zero when the lead becomes parallel to the axis. On the other hand, the pressure-generating ability starts from infinity at zero lead and steadily declines to zero at 90° lead.

The formula for calculating the pressure-generating ability at block-off rate of screws having various helix angles is:

$$G = P_n(\operatorname{cosec}\phi)\frac{L}{\tan\phi c}$$

where G = Pressure gradient in length of screw;
P_n = Pressure drop when material flows perpendicular to flight face;
ϕ = Helix angle;
L = Length of screw, in inches; and
c = Circumference in inches

The increase in pressure-drop due to increase in velocity is taken as being in direct proportion for the velocity ranges involved here.

The above formula may be expressed in simpler terms, as follows:

$$G_1 = P_c\frac{D}{e}$$

where G_1 = Pressure gradient per diameter of length;
D = Diameter of screw;
e = Axial flight pitch across the channel only (not including flights); and
P_c = Circumferential pressure drop

Thus, the pressure-generating ability in an axial direction at block-off for a given length screw will vary inversely with the lead.

The pressure-generating ability at block-off rate and the open discharge capacity (flights only moving and ignoring the friction of the sides of these flights) varies with the helix angle as illustrated in Figure 11. Two important points must be borne in mind relative to this conclusion:

(1). This is based on an idealized system. The effects of surface friction must be added to this representation to give it practical value. Of course, an extruder having only the helix rotating would not be very different in operation from the figures shown but of the stem of the screw rotates as is the actual condition in extruders, the change is large.

(2). We still must explore out-put volumes vs. pressure-generating ability to select a worm of practical value.

Restricted Flow & Pressure Build-Up

If the restriction is partial and axial flow still is taking place, calculations can be made in a manner similar to the above (as illustrated in Figure 12). In this case, the normal open-discharge flow would be from "S" to "N", but a resistance at the die has deflected the flow

so that it is from "S" to "Z". There will be a high pressure at "S", and zero pressure at "Z". The line S-Z_1 will be the line of no pressure-gradient, another increment of pressure will occur along line S_1-Z_1, and so on.

Any appropriate means may be used to determine pressure drop from "S" to "Z" and the relationship of the axial component S-A of line S-S_1 to the total length in order to give the pressure-generating ability.

Relating to the same idealized mechanism used above, a chart can be plotted showing the rate at which a screw of given characteristics will generate an increasing pressure as the cross-flow path is deflected from the binormal by a restriction at the discharge, and also relate this to the drop in out-put.

The pressure drop across the channel will increase directly with the increased distance it must flow across the channel multiplied by the factor for the increased speed at which it flows when so deflected. We will adopt the arbitrary standard that the pressure drop increases directly with the increase in velocity. Thus, for our present purposes, we will say that the cross-channel pressure drop varies as the square of the variation in cross-channel flow distance.

Figure 12 illustrates a partial deflection in flow from "S" to "Z" intermediate between the flow at open discharge "S" to "N" and the flow at blockoff "S" to "O". All the material in the screw channel is flowing in the direction S-Z. If we erect a perpendicular S-Z_1, there will be no component of flow along the direction S-Z_1, and there will be a uniform magnitude of pressure along this line. By calculating the cross-channel pressure drop S-Z and relating the axial component S-A of S-S_1 to the length of the screw, we can determine the pressure-generation gradient for the length of the screw.

This can be solved by the following formula:

$$G_1 = P_n \frac{(\sec \theta \cdot w)^2 D}{w^2 \cdot w (\operatorname{cosec} \theta) \cdot (\sec \theta) \operatorname{Sin} \phi)}$$

where G_1 = Pressure gradient per diameter of length;
ϕ = Helix angle;
θ = Angle of flow deflection from binormal;
P_n = Pressure drop in normal cross-channel flow;
D = Length of screw = one diameter; and
w = Channel width normal to helix angle

This formula can be reduced to

$$G_1 = \frac{P_n D(\tan \theta)}{w (\sin \phi)}$$

Thus we see in Figure 12 that the mechanism by which a pressure-drop flow across-the-channel is converted into a concurrent flow and pressure rise from feed hopper to die.

This value solves to a constant for a worm of a given diameter and a given perpendicular cross-channel pressure drop and, thus, the pressure gradient generated with restriction of flow will follow a tangent curve. By plotting the pressure-generating abilities of four screws having axial leads of ⅔, one, 1½, and two diameters, it was noted that the pressure build-up at any given angular deflection of flow from normal cross-channel flow is the same, regardless of the helix angle of the worm. Of course, the limit of pressure-generating ability of the worm is reached when the flow is deflected from the normal to an angle complementary to the helix angle (that is, circumferential flow).

Extrusion efficiency is calculated in percentages of open discharge rate. In figure 12, the maximum open discharge rate would be represented by the axial component of line S-N, while a restricted-flow rate is represented by the axial component of line S-Z. In single-flighted screws, this is represented by:

$$E = \frac{(\cos \phi) c - (\tan \theta) w}{(\cos \phi) c}$$

where E = Efficiency as percent of open-discharge rate; and
c = Circumference of screw.

This also solves as a tangent curve, so we find that a plot from 100% out-put at open-discharge to 0% at block-off gives an answer in which the efficiency curve coincides with the pressure curve. Thus, the rise in pressure from zero at open-discharge to maximum at block-off and decrease in rate from 100% to 0% occur at the same rate for any given screw.

Pressure Generation vs. Volume Out-Put

The next step is to relate the pressure-generating ability of the worm to its volume out-put. Accordingly, we will take into consideration the fact that the open-discharge rate increased as the lead increases from zero to 45° and we will find how much advantage can be taken of this.

In figure 13, curves are plotted for the same screws used before, but the pressure is related to a factor representing the absolute out-put in cubic inches instead of to the out-put efficiency. It is notable that the out-put of long lead screws, up to two-inch diameters (45°) have high through-put rates if pressures are low, but rapidly lose their advantage as the discharge pressure rises. This is plotted for a group of two-inch diameter screws with a depth of ⅛-inch and a perpendicular cross-channel pressure drop of 10 psi., where the screw has an axial lead of one diameter.

The pressure-output line for a screw having a 45° helix angle (maximum open-discharge rate) has been included and also two screws of longer lead having helix angles of 60° and 75°. As the helix angle goes above 45°, both out-put and pressure decrease while the rotation of the material with the screw is increasing. This rotation reaches 100% at a helix angle of 90° (flight parallel to axis) and, at that point, both pressure-generation gradient and throughput have disappeared entirely.

The solid line represents the ultimate that can be accomplished by any extruder worm processing a Newtonian fluid if the lead of the screw were chosen specifically to have the optimum combination of pressure-generating ability and out-put. To obtain an operation giving a balance of pressure and out-put that is represented by a point on the line, a screw with the corresponding helix angle would be required so that its pressure-rate line would fall tangent to the solid line at the desired point. For a combination falling inside the line, a range of helix angles can be used.

(*Continued on page 54*)

R. R. MOYER, *Asst. Director of Technical Service, Plastics Div. Monsanto Chemical Co. Springfield, Mass.*

Developments During 1958 in Processing of Plastics Materials

1958 may be considered an unusually productive year with respect to technological advancement in the processing of plastic materials. The effect of these gains finds measurement in terms of improved product quality, lower unit cost, and higher output rates. In certain instances, the technological break-through to effect fully automatic production was achieved or brought within the realm of early commercial probability.

The past year's decline in economic activity has served to emphasize the need for a high rate of technological advance both in equipment and materials if the plastics industry is to maintain a rate of growth consistent with that of the decade which followed the close of World War II. Further, it is important that the use of new methods and equipment be oriented toward new applications rather than receive primary exploitation as price cutting mechanisms applied to existing markets and products.

Our review will be concerned with equipment developments, and emphasis will be placed on the processing areas of injection molding and extrusion. It should be recognized that some of the equipment innovations under consideration represent refinements of technology which were evident on a limited basis in preceding years and just recently have achieved commercial status.

Injection Molding

Valved control (restriction) of the injection charge was perhaps the most active phase of design innovation and refinement during 1958. Commerical practice involved incorporation of a valve (or valves) in the mold runner system, in the injection nozzle, or in "crosshead" sections adapted to the heater and fitted with nozzles that lead directly into the mold cavities. By the latter half of the year, all domestic injection machine manufacturers had incorporated a valved injection control in at least one of their models.

Three elements of control in the process of injection molding underlie the use of valve systems, as follows:

(1). Elimination of material discharge into the mold or mold runner system while the injection charge is being pre-compressed for release on the next cycle;

(2). For pre-plasticizer heater systems, to allow fill of the "shooting cylinder" without causing nozzle drooling; and

(3). To regulate the moment of charge of material to the mold or to an individual mold cavity, and to seal-off that mold cavity at the moment of adequate fill.

The main basis for utilization of a valve system is represented by Figure 1. In its simplest aspect, a valve in the nozzle closes immediately upon completion of the injection phase of the cycle, and the ram is cycled one or more times to pack a thoroughly plasticized charge of material to a degree that approaches the compressibility limits of the thermoplastic material involved. The ram is held forward under full pressure and when the mold is closed and ready for injection, the valve opens releasing pre-compressed material to be injected into the mold under full ram pressure.

The kinetic energy of the pre-compressed material combines with the high-efficiency pressure transfer of the pre-positioned injection ram to effect near instantaneous fill of the mold cavities.

The valve gating of injection molds* functions in a similar manner to utilize the energy of pre-compres-

*U. S. Patents 2,770,011 and 2,773,284 (The Columbus Plastic Products Co., Columbus, O.).

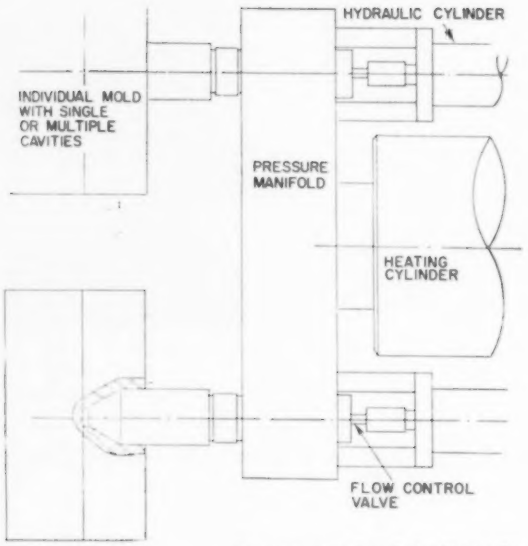

Diagram courtesy: Bopp-Decker Plastics, Inc.

Fig. 1. Schematic diagram of two-nozzle lay-out for sequential impact molding using two separate nozzles.

sion and of efficient injection ram advance. The runner system is heated to eliminate freeze-up. When the cycle element for mold fill is actuated, the valves open simultaneously to allow rapid fill of the injection cavities. This method represents an advance over the hot-runner technique insofar as the pressurized runner system equates the rate of fill from cavity to cavity, and minimizes the need for control of rate of cavity fill previously regulated by the geometry of the gate and runner system.

Sequential impact molding# utilizes a pressure manifold adapted to the discharge end of the heating cylinder with material being charged directly to the mold cavity (as in runnerless molding) utilizing two, three, four, or more nozzles as required. Mounted to the pressure manifold are flow-control valves actuated by a hydraulic cylinder which functions to control the opening and closing of the valve. The term "sequential" relates to the characteristic that each nozzle in the manifold is controlled individually by a timer system in elements of 2/100's of a second. Thus, by pre-selection, the mold cavities or sub-cavity areas of a mold may be released for "fill" in sequence or in series.

Another injection machine development which achieved commercial status during 1958 is one that utilizes an extruder for plasticizing and also incorporates valved injection control. The initial commercial machine, while designed primarily for high-speed stock package molding, has also been found to be highly efficient for molding a variety of thermoplastic materials to produce custom industrial articles (see Figure 2).

The "Jetflow"** extruder operates adiabatically to work and plasticize the material physically as it moves forward through the screw section. At the discharge end of the barrel, ports in the screw tip accept plasticized material to fill the hollow bore of the screw. The operation of the extruder screw is constant, and the plunger within the hollow screw bore injects cyclically, synchronizing its advance with the opening of the nozzle valve to release material to the mold cavity. For certain designs of tools, the partial fill of the mold prior to complete closing may be effected.

#Patent and Registration applied for by Bopp-Decker Plastics, Inc., Clawson, Mich.
**U. S. Patent 2,680,880, registration applied for by Reed-Prentice Division, Package Machinery Co., Worcester, Mass.

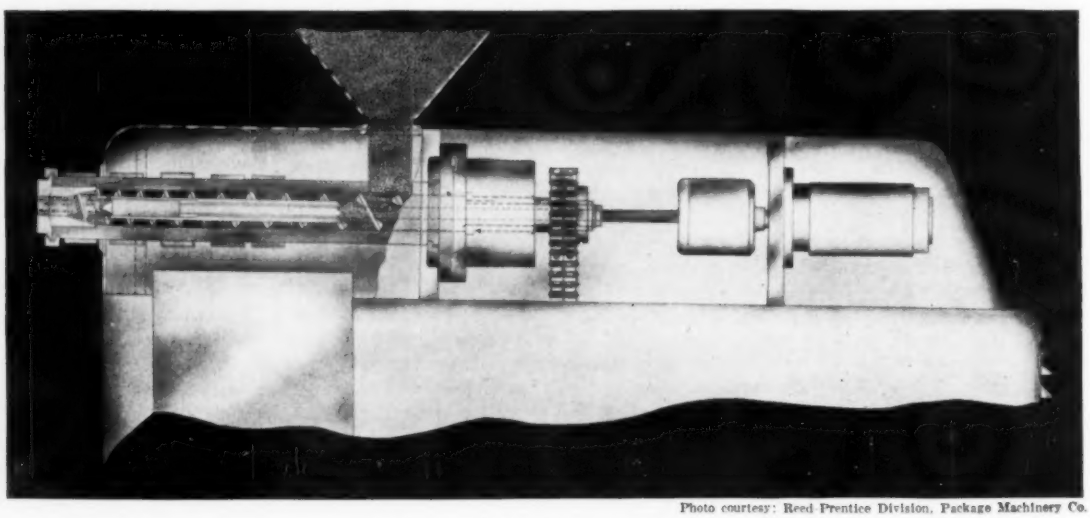

Photo courtesy: Reed-Prentice Division, Package Machinery Co.

Fig. 2. Cross-sectional drawing of "Jetflow" extruder.

This feature allows a combination of compression and injection molding of thermoplastics, which initial studies indicate may be desirable as a means of reducing oriented strain in the castings.

An important performance feature of this initial model of extruder-molder is the rapid rate of mechanical action. Operating on automatic cycle to mold 0.012-inch wall containers, over-all cycles under two seconds have been maintained. The manufacturer's specification rates plastication of polystyrene at 100 pounds per hour and dry cycle at 1.3 seconds.

A careful study of package molding operations and the performance requirements of high-speed, single-cavity molding operations has provided the basis for a number of design innovations observed in a new two-ounce machine. The press platens are channeled for heating and cooling. A mold mount recess in each platen allows for the elimination of die plates. The instruments and controls are shock-mounted in the press frame to save space, while reducing the hazard of excess maintenance. A shut-off nozzle provides for pre-compressed molding, and a photoelectric recycling monitor safeguards automatic operation (see Figure 3). Part ejection is at the end of the press to simplify conveyor handling.

Injection Summary & Trends

The new, small machines introduced in 1958 provide for cycling rates that are not likely to be exceeded by fixed-mold and single-plane platen systems.

Further efficiencies will be realized from the use of pre-compression techniques and programmed timing of valve control. This will include the use of multiple-nozzle injection, sequentially timed to fill a series of sub-cavities, the total projected area of which would greatly exceed the clamp capacity of the machine. However, by sequential injection, the effective projected area will be held well below clamp capacity. Also, multiple nozzle injection may be utilized to control the fill pattern (and weld lines) in large-area moldings of complex and unbalanced geometry.

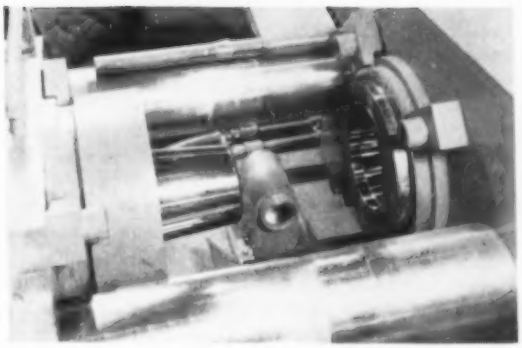

Photo courtesy: Improved Machinery, Inc.

Fig. 3. Expanded view of shut-off nozzle for pre-compressed injection molding.

All machine manufacturers are emphasizing constructions which minimize and simplify maintenance.

Recognition of floor space limitations and the potential use of injection machines in integrated automatic production lines is leading to the compacting of machine dimensions.

New machines of all sizes (up to 300 ounces) provide for more rapid plunger advance, and far greater uniformity of the injection charge both in weight and stock temperature.

Extrusion

The primary emphasis on extrusion equipment development has been to secure an increase in out-put rate and quality of product, be it sheet or profile. The recognized barrier of the past, in this latter respect,

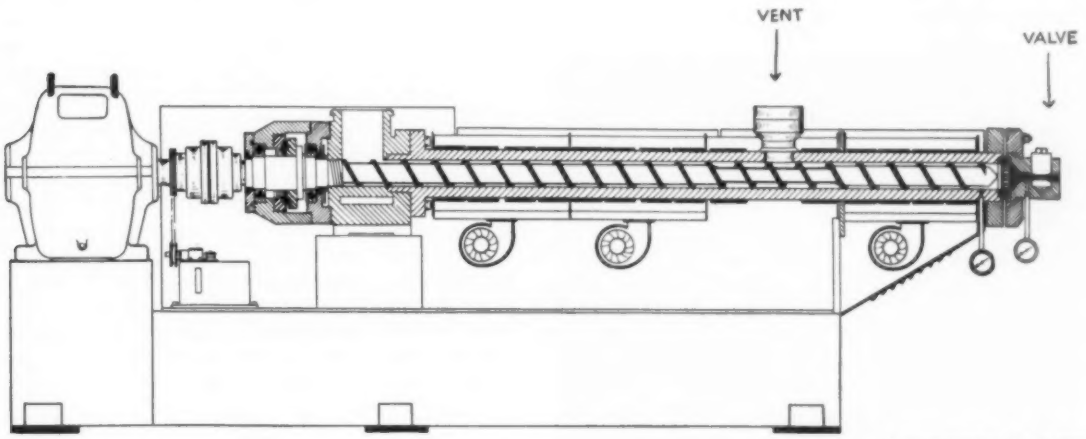

Diagram courtesy: Prodex Corp.

Fig. 4. Cross-sectional view of devolatilizing extruder with two-stage screw and valve.

usually has been the elimination of volatiles and the avoidance of surging.

The obvious and initial step in securing more uniform and adequate working of material was to increase the barrel length. For polystyrene sheet extrusion, in particular, the majority of all extruders purchased and installed in this past year have had a ratio of 20:1, and numerous new units have been installed with ratios of 24:1. A corollary design feature has been the devolatilizing vent (see Figure 4). A two-state screw must be used in conjunction with the devolatilizing vent, since a reduction to zero pressure must be maintained in the vent area.

Normally, the combination of breaker plate, screen pack, and extrusion die function to control back-pressure in the process. Where minor lack of uniformity of heat control in feed or material plastication existed, surging that would cause poor extrudate finish or lack of cross-sectional uniformity often developed. The use of an adjustable pressure valve eliminates total dependence on the die, breaker plate, etc., for control of back-pressure.

When optimum out-put rates are desired, and air or volatile entrapment in the extrudate are evident even with the use of a devolatilizing vent, the use of a vacuum unit has been known to remove a critical volatile increment. Under development but not available on a commercial basis, is a unit that applies a vacuum on the feed hopper. Experimental trials concerned with the extrusion of high-impact polystyrene sheet have shown out-put rate increases of up to 25% without the development of air entrapment.

In addition to the development that has been applied to controlling or eliminating volatiles, and to regulating the passage of the plastic melt through the extruder, new approaches to design for extruder screws are considered most important. No single design feature here can be selected as optimum. However, the important factor observed during 1958 has been that each thermoplastic material will perform better with screws designed specifically for that material's rheological characteristics. A most recent example of this approach was observed wherein a general screw design was producing at the rate of 375 pounds per hour in a 4½-inch extruder. The installation of a specifically-designed screw in the same machine has raised the out-put to more than 500 pounds per hour. It is obvious that rate increases such as the latter (33%) warrant attention to this facet of extrusion technology.

The other significant development, relating specifically to extruders, has been the evaluation of 60-cycle induction heating. This is the type of heating where a magnetic flux is set up in the barrel of the extruder by passing an electric current around the barrel and, thereby, resulting in the generation of heat in the barrel. It has the advantage that the temperature variation across the barrel is relatively low and heat-up time is rapid. Proponents of this method of heating indicate that uniform barrel temperatures can be maintained at a lower cost than with any other type of heating.

Each of the developments referred to in this extrusion section treat with the means of eliminating undesirable elements of the extrudate in order to allow higher rates of through-put. No detailed mention is made of numerous experiments which are being conducted in high-speed extrusion, wherein speeds of 200-300 rpm. are under evaluation. No single effective development in extrusion should be overlooked, since the high out-put rate of this type of equipment in relation to capital investment required serves to indicate its continued rapid growth as a means for plastics processing. —THE END

Development of Steam-Resistant Fiberglass-Reinforced Plastics

(Cont'd. from page 38)

durability of the premium-quality products obtained from preforms with Dacron overlays. The simplicity of the "Gunk" molding technique is shown in Figures 5 and 6. The same dies are used as in Figure 1. A weighed quantity of heavy-consistency compound is laid into the center of the male die (see Figure 5), the press is closed and, after curing for 4-5 minutes, the finished basin is extracted from the mold (Figure 6 shows the finished basin lifted off the male die).

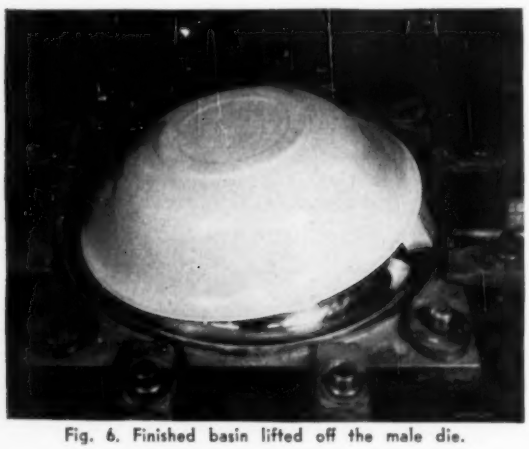

Fig. 6. Finished basin lifted off the male die.

The compound used in our exploratory production experiments was made by the Thermoflow Corp.* In greater part, this compound is a heavy-consistency blend (see Table 4) of Atlac 382E, styrene, 3/4-inch glass fibers, clay (Edger Bros. ASP 1300), and enough of the pigment paste to adjust color to the standard.

Conclusions

The low cost and simplicity of the premix molding process over the premium-quality preform-Dacron process is obvious. Products molded from premix compound can compete with many thermoplastic, injection-molded products with reference to strength, and come very close to having a competitive surface finish. They lack the impact resistance of the products made from preforms when tested by dead-drop on concrete, but resistance to edge-chipping is as good as with the more costly product. —THE END

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Huntington Station, N. Y.

Reinforced Plastics

Fiberglass Advantages in the Small Boat Field

To the small boat owner and to the man who has always wanted to own a boat with a minimum of maintenance and a maximum of enjoyment, a "new age is here"; the age of the fiberglass boat. The development of glass fiber-reinforced with resin as a prime structural material for boats is the greatest single advance in boat building since man first took to the water in small boats to seek his food, for transportation and for pleasure.

Why is fiberglass so important a material? Wood boats float; aluminum boats are light in weight; and steel boats are fairly inexpensive. The answer is fourfold. Firstly, fiberglass boats are strong. Pound for pound, fibrous glass reportedly is the strongest structural material known. Secondly, laminated fiberglass withstands tremendous impact. The Army experimented for years with bulletproof vests made of steel, but found that although a steel vest would stop a rifle bullet, in applications it was too heavy to be of any practical value. By making bulletproof vests of many thin, overlapping fiberglass shingles or scales, a highly successful protective vest was developed at a weight of only 11 pounds. Fiberglass has the inherent property of absorbing tremendous impact without sustaining puncture. Therefore, a collision with a submerged rock that would probably sink a wood boat is likely to do little damage to the plastic surface of a fiberglass boat. Also, repairs are very easy to do on a boat molded from reinforced plastics.

Thirdly, fiberglass is almost universally moldable. This means that the designer and builder are practically unlimited in the use of curves and contours that are the ultimate in beauty and styling, but which, if used in boats built of conventional materials, would render them so expensive that they could never be brought into production.

Fourthly, and probably of greatest importance to the amateur boatman, fiberglass boats stay strong. The life of a fiberglass boat from the day of launching is not a story of gradual deterioration, loosening at the seams, rotting and loss of strength. Fiberglass boats are strong when they are new, and they stay strong because fiberglass materials and the synthetic resins with which they are bonded together are chemically inert and almost ageless. They are not subject to damage by sunlight, salt water, rust, gasoline, dry rot or marine bacteria. The average boatman—the man with a family who wants a boat for fun—doesn't have to be a wood expert or a metallurgist in order to be safe and confident in a small boat. Gone forever is the well-known probing for dry rot with a pen knife, or ice pick and the tapping for undiscovered corrosion with the chipping hammer. In short, fiberglass boats are made maintenance-free and for pleasure. They free the boatman from the backbreaking annual drudgery of caulking, scraping, sanding and painting.

Let us consider another aspect of the small boat: the number of pieces that go into it. For centuries, man has built boats from hundreds of small pieces that are cut to shape and fitted, glued and fastened together to form what is not really a very large finished structure. Man has accepted the necessity of building boats this way because boats just could not be constructed effectively in one piece. Not that he wouldn't have liked to, but there just wasn't any material available that would permit it, until now. The modern fiberglass boat, in essence, is a light, tremendously strong, one-piece shell built from materials that scarcely change—for the modern boat-owners who want fun, not worry; relaxation, not maintenance.

For these reasons primarily, the manufacture of small boats has become one of the major products of the reinforced plastics industry. Last year, for instance, small-boat manufacturers consumed 38,000,000 pounds of glass, and the outlook for next year is estimated at 30% above that figure.

—The End

Edited by:
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Newark Die Hobbing & Casting Co.
Newark, New Jersey

Moldmaking & Tooling

What's New in Mold Making

No doubt many of you were fortunate enough to have attended the 8th National Plastics Exposition in Chicago last November. For those of you who did not attend, and to refresh the recollection of those who did, I should like to review and point up what might be considered new in the field of mold making.

The Exposition itself was indeed a success, as well as a tribute to the plastics industry. Many of the exhibits were spectacular in their display of end-products, machinery, materials and allied services. For those who wished to probe further, courteous booth attendants were eager to discuss problems or describe process techniques to interested parties.

For those interested in the field of mold making, there were but few exhibits specifically showing molds or their design. One of these few was an extremely interesting display of mold construction, in keeping with the theme of the Exposition, "Plastics for Profits." The display featured a complicated mold used in the molding of thermoplastic closures incorporating the functions of automatic degating and automatic unscrewing. The mold frame, including the unscrewing and degating mechanisms, is offered as a standard unit of construction. Interchangeable mold components, comprised of cavities, forces, and bushings, enable a molder to change from the molding of one closure to the molding of another by merely substituting a new set of components. The main portion of the mold being utilized over and over again materially reduces the mold cost in going from one closure application to another.

As I said earlier, there were few displays of molds by themselves. For a more complete story of new advances in mold design, one had to approach the subject through observation of the end-use items displayed, as well as the material applications, and the molding machines in operation.

Most significant was the increase in speed of many of the molding operations. Let us analyze this feature from the mold point of view. As the press functions become more rapid, the emphasis for cycle reduction leans more and more heavily on the length of time it takes for the molded part to cool sufficiently for ejection and dimensioned stability. Since this cooling takes place in the mold, it might be well for those of us concerned with mold design to review our thoughts about mold cooling. Perhaps, in the very near future, the conventional drilled cooling lines in the moldplates, and the occasional cooling lines in the larger cavity or force components, will not meet the demands of the more rapid molding cycles. This would be especially true for multiple-cavity molds used in the latest injection molding presses. We should investigate materials for mold construction having the higher degrees of heat conductivity, as well as designs bringing the cooling medium closer to the molded article. In short, mold cooling should become one of the principal features of design.

Along the same line of thinking, we very often find that the "cure-time" portion of a cycle in a thermoplastic molding application is not always a function of the molded part, but that of the runner system. In many instances, the runner represents the heaviest section, and its cure time governs the cycle. Perhaps this is the reason why so many of the molds in operation at the Exposition were either of the hot runner type or some modification of it. At any rate, hot runner designs most certainly go hand in hand with the faster molding cycles. A second, and most important advantage of hot runners is the increased "pay load" per shot. The plasticizing capacity of the press, needed for the runner system, can very well be utilized for molding additional parts with the same effort. *(Continued on page 54)*

Edited by:
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Compression & Transfer Molding

A Veteran Molder Speaks On Shrinkage Control

WHEN a molder receives a new drawing for quotation purposes, he is immediately confronted with the dimensional tolerances he is expected to hold. On the basis of his experience, he makes a judgement regarding which tolerances are possible and which are not. He then returns the drawing to the customer with his own suggested tolerances. Quite often, the material maker is brought into a discussion on shrinkage control, but usually the matter is left up to the discretion of the molder.

Many a job has been lost due to the difficulty encountered in holding dimensions. Yet, phenolic materials are noted for having a distinct advantage over other available plastic materials on this very point. The molder usually relies on the data sheet of the selected compound as a guide; however, the shrinkage given in a data sheet is not the total story on shrinkage. The data-sheet figure is based on a positive-type mold (ASTM type). The range usually indicated is the variation between soft to hard plasticity (or flow), plus the slight variation that can occur in measurement. Also, the shrinkage tolerance shown does not take into consideration the variation due to another mold-design type, molding pressure, molding temperature, cure time, preheating, pre-drying, closing time of mold, or the effects of different charge weights. The material maker knows that the more constant these potential variables are held, the better the chance of holding closer tolerances.

It is not the purpose of this article to point out how closely tolerances can be held, but to note how shrinkage can be changed in almost any thermosetting compound. May I now relate an actual experience in controlling molding techniques which perhaps might prod the molder to investigate the ways and means of holding closer tolerances.

During a service call to a well-established molding concern, I had occasion to visit with their molding superintendent. This unnamed molding superintendent is a man in his early sixties, and is a real veteran in the thermosetting plastics industry.

The reason for my call was to review molding techniques involved for a 14-inch diameter pulley. It soon was evident to me that my potential contributions were not necessary. My services had been obviated because of the excellent knowledge of molding already available. Most important of all, it was gratifying to note that good control of shrinkage had been developed during the cycling-in process. During a coffee break, the molding superintendent virtually purred with satisfaction over the success of the project. Naturally, congratulations were in order. As our tete a tete was terminating, we got into a discussion of shrinkage control. My companion said, "Paul, for a great number of years I have been using very basic logic for establishing molding control. Last night," he continued, "I thought I would write down some basic facts on shrinkage control so that they would be available to my successors."

He then showed me a couple of ruled, yellow, notebook sheets on which he had made some entries. On looking over his notes, I saw that he had simplified much that has been written before on molding-shrinkage control. These notes were not laboratory results, but were the practical observations of a practical man.

I asked him if he cared to let me copy them for general use. He seemed to hesitate first, and then said, "Well, I see no reason why you shouldn't. The information is not revolutionary. It might help you and others in solving another molding problem sometime."

In furnishing this information to the reader, I wish to affirm that full approval has been obtained from the

(*Continued on page 54*)

PLASTICS TECHNOLOGY

EXPLORING FABRICATION TECHNIQUES

By L. J. ZUKOR, *Engineering Editor*

Continuous Metallizing . . .

. . . of plastic web material by the vacuum method is a process of applying a coating (in most cases a metal) to the surface of the web as it travels from an unwind station to a take-up station in a vacuum chamber. Employed for both functional and decorative applications in the industrial, automotive, and housewares fields, this process can be used to deposit many different metals. However, aluminum is most widely used because it is easily evaporated in vacuo, forms a brilliant mirror-like film, is corrosion- and tarnish-resistant, and is relatively cheap and plentiful.

The continuous method differs from the batch method primarily in the feed of the metal being evaporated. Since the process itself is continuous, the metal must also be fed in a continuous fashion. This is usually accomplished by feeding it automatically in wire form from a reel. Another difference is in the heater, which is a boat made of a refractory metal or block carbon. The first successful continuous metallizing operation was made possible by the application of tantalum to the carbon heater so that the molten metal would wet and spread across the heater surface and not be absorbed into the carbon. This coating of the carbon block increased its life, thereby allowing for the necessary time to coat hundreds of feet of material being run. A complete run takes from 60 to 100 minutes, and speeds of about 60-75 feet per minute are possible. Further advances in the technology of heater design have increased the speeds upwards of 300 feet per minute.

In plastics, the most successful material to be continuously metallized is Mylar polyester film. This material, if clean when received for metallizing, does not require an outgassing operation. All of the other plastic materials have been tried with varying success. Some require an impervious outer cover before the metallizing operation, and others require an expensive outgassing operation. The plasticized films have been extremely difficult to coat in the high vacuum necessary in the process, and also show poor adhesion of the metallic film.

Some of the latest developments in the field of continuous metallizing have come from the laboratories of National Metallizing Company in Trenton, N. J. One of these is a flexible resistance heater made of metallized 2-mil Mylar laminated to another sheet of 2-mil Mylar film. This material is said to be completely safe, since the coating burns out in the vicinity of a puncture so that the electrical path is opened. National Metallizing has also prepared the material used for special inflated satellites that are used as radar reflectors.

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Metallized Mylar satellites will be propelled into space in a deflated condition, ejected into orbit and automatically inflated by a nitrogen gas cartridge. (See Cover Photo)

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Another very successful producer is Coating Products Co., in Englewood, N. J. This firm also specializes in embossing and laminating the metallized film.

The use of metallized films is growing steadily. Electronic research laboratories and others presently experimenting with this material will, in the near future, bring forth new industrial applications. This expanding trend will over-shadow the decorative uses; however, this will in no way reduce the decorative value of metallized films. The newer laminates and metallic yarns are opening new and untried markets. Items such as candy wrapping and thread inclusions in men's ties are presently being tried.

Photo courtesy: Coating Products Co.

Embossed metallized Mylar laminate used in decoration.

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New Materials . . .

. . . new processes and new techniques contribute to keep Plastics an expanding and successful industry. One

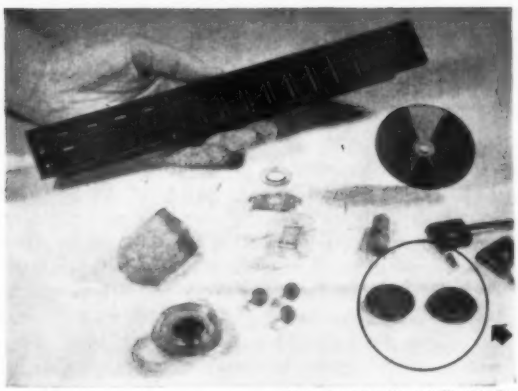

Photo courtesy: General Electric Co.

of the latest material entries to come out of the laboratory and into regular production is Lexan, a polycarbonate resin created by the General Electric Company.

Manufacturers who have experimented with and used the resin report that the material can be used in their standard equipment without special modification. Anchor Plastics of New York City, extruders, report that Lexan is "the only transparent thermoplastic material we have used that can be sterilized with live steam." Other molders report equally good results working from basic information contained in technical reports supplied by the manufacturers.

This material is extending the use of clear thermoplastics that started with the cellulosics in low-temperature applications to similar end-use employment where high temperatures are encountered.

Circled in the photograph is a lens cap molded by General Electric Co., Decatur, Ill., for Revere Camera Co., Chicago, Ill.

This part was molded on a Reed-Prentice standard four-ounce machine in a two-cavity mold. The mold was originally designed for use with cellulose acetate butyrate and the shrinkage factor was such that no modification was needed with the new material. It was approximately 5 mils per inch.

The two heating zones of the machine were set at 600° F. at the rear and 580° F. at the front. No heater was used on the nozzle, although the material manufacturer recommends that one be used. The mold was run at room temperature by circulating room-temperature water, this also deviated from the recommended practice of a heated mold. The ram time was seven seconds, the booster five and a half seconds, and the cure time seven seconds, to a total cycle time of nineteen seconds. The balance of time was used in opening and closing the machine. The hydraulic line pressure was full at approximately 1,000 psi.

At the end of each cycle, the sprues and runners were re-fed to the machine. In the heated condition, they were free of moisture and when re-fed immediately, did not collect dust and dirt.

Prior to molding, the resin was preheated to 250° F. in the cans before being introduced into the machine hopper. No hopper heater was used; however, this also was recommended for most applications.

The weight of the shot was 24.9 grams and the weight of the parts was 16.4 grams with 8.5 grams or 34% regrind.

Another point of interest is that Lexan has been successfully dyed without dimensional change in size. The dye material penetrates to approximately two mils in depth. In appearance, the dyed piece has a homogenous color from transparent through the opaque range. A company specializing in dyeing this material is Colorite Industrial Dyers of New City.

●

Vinyl-metal Laminates . . .

. . . are taking a ready-made market away from the familiar painted metal products. These materials offer better "feel" and considerably more decoration than a painted surface. They also supply the same protection against corrosion to the metal, plus higher dielectric qualities.

The process for manufacturing vinyl-metal laminates was developed concurrently in 1954 by Hood Rubber Co., Division of B. F. Goodrich Co.; Naugatuck Chemical Division, U. S. Rubber Co.; and O'Sullivan Rubber Co. Variations in equipment and bonding adhesives generally differentiate the laminating processes; however, all give similar vinyl-metal laminates.

One manufacturer, Poloron Products, Inc., New Rochelle, N. Y., is a licensee of Naugatuck Chemical's "Marvibond" laminating process. This company supplies sheet and fabricated parts to industry, while also preparing the material for its own use in manufacturing proprietary products bearing the Poloron trade name.

As the material is conveyed down the mechanized production line, it is first treated with a chemical wash to remove all surface impurities and give "tooth" to the metal for the mechanical bond of the adhesive. After drying, the sheet is transported to a roll coater where it receives a coat of adheisve. In the case of steel, the adhesive is coated top and bottom; the bottom coat taking the place of paint for corrosion protection. From this point, the metal sheet passes through a two-stage oven. The first stage is set at a temperature just high enough to evaporate the solvent without causing it to boil in the adhesive film. In the second stage, the sheet and the adhesive (in this case, a modified epoxy adhesive manufactured by the Stanley Chemical Co.) are heated to 390°-400° F. to cause cross-linking or cure of the resin material. While the sheet is still hot and before full cure of the resin occurs, the metal sheet is immediately brought in contact with the vinyl material and both move together through a set of pinch rolls. The lower roll is the driver, and the upper roll is loaded to produce 60-80 psi. pressure. Both rolls are resilient, and the roll in contact with the vinyl, is covered with a release agent such as Teflon or silicone. The vinyl material is usually fed from a roll mounted above the pinch rolls. After leaving the pinch rolls, the laminated material is cooled by a water spray or air blast, then stacked for shipment or use.

Quality control tests are made periodically on production samples. The test consists of indenting a three-

(Continued on page 54)

Moldmaking & Tooling
(Cont'd. from page 50)

Let us not overlook a relatively new type of molding that presently is getting its share of interest from many portions of the industry. Blow molding seems to have come to a point where future applications will certainly call upon the moldmakers to supply the increased need for tooling. Although the technical features of mold design for blow molding have not been widely distributed as yet, at least two features seem to be specifically stressed; low cost and careful attention to cooling.

In conclusion, if we can go by what was featured at the Eighth National Plastics Exposition, the moldmaking industry should get ready to meet the need for shorter molding cycles, more positive cooling, increased numbers of hot-runner applications, and keep an eye on blow molding. —THE END

Compression & Transfer Molding
(Cont'd. from page 51)

molding superintendent. As indicated, the work is not necessarily original nor incontestable. It is just a statement of empirical knowledge on methods for shrinkage control, as expressed by a conscientious man employed by a very reputable molder.

Methods of Obtaining Shrinkage Control

Requirements for more shrinkage:

(1). Minimum weight of material (to the point of shorting);
(2). Softer flow material (to the point of no-blisters);
(3). Minimum molding pressure (to the point of just filling);
(4). Minimum cure (Note: Mold temperature should be to high side);
(5). Minimum to no preheating of material;
(6). Minimum time to close mold (Note: Not too fast to avoid mold damage);
(7). Do not pre-dry material. (Note: Conditioning often is necessary for better electrical properties);
(8). In extreme cases, close mold on minimum pressure required to close it completely and, after a few seconds, breathe mold, then close again on reduced pressure, and cure on this lower pressure—this should allow some shrinkage in mold while part is curing;
(9). For more extreme shrinkage, keep the pressure on mold landings and not on the piece-part during cure time; and
(10). Clearance in mold between punch and cavity will vary shrinkage—the more clearance, the more shrinkage.

Requirements for less shrinkage:

(1). Maximum weight of material possible (Note: this will not hold true with molds allowing free escape of material);
(2). Hard flow material (more molding pressure might be required);
(3). Maximum molding pressure;
(4). Maximum cure and minimum or normal (320° F.) mold temperature;
(5). Maximum preheat of material (to the point of no pre-cure);
(6). Maximum time to close mold (close as slowly as possible and still properly fill piece and close mold);
(7). If possible, pre-dry material in oven at 140-150° F. for 4-8 hours, and drive out all moisture (much depends on volatility content);
(8). For least shrinkage, overload enough to keep pressure on piece part, but not enough to keep mold open (uneven overflow of material will cause variable density and, consequently, irregular shrinkage); and
(9). Clearance in mold between punch and cavity will vary shrinkage—minimum clearance assists in minimum shrinkage.

It should be noted that the remarks in parentheses are the writer's comments.

It is my hope that forthcoming articles will help both molder and end-user to become better acquainted with engineering facts behind thermosetting materials. It is only through education that the field of plastics can continue to grow. If my approach is pointed more or less toward the layman and the newer men in our field, it is only because they will some day be determining the new fields of endeavor for plastics.

The next article will again feature a phase of molding techniques. In the making, is a basic cure-time chart showing what affects the cycle time. —THE END

Extrusion Theory—Part II
(Cont'd. from page 44)

Actual Extruders

Next comes the difficult problem of determining the frictional effects of the metal surfaces, effects of viscosity and viscosity variations, temperature build-up, and other conditions that exist in an extruder, the solution of which is essential if useful quantitative calculations are to be made. —THE END

Vinyl-metal Laminates
(Cont'd. from page 53)

inch square of the material having an "X" cut through on the vinyl side. A hemispherical indentation is made on the metal side by a one-inch hardened steel sphere. Rejection or acceptance of the material is based on whether or not the vinyl separates from the metal at the cut section.

Much of the development work being carried on in the laboratories is in the field of adhesives. In the past, thermoplastic adhesives have been used successfully. However, the advantages of a lower laminating temperature becomes a disadvantage when the end-product delaminates on approaching this temperature. The thermosetting resin adhesives show better delaminating characteristics, but require a higher laminating temperature to bond the materials. One of the problems has been to keep all the advantages that the thermosets offer and, at the same time, reduce the heat necessary to create tackiness and cure in the bonding material. —THE END

News of the Industry

Plastics Industry Hits New High

Production of plastics and resin materials in 1958 increased 5% over the previous year, reaching a new high of 4,544,000,000 pounds—according to The Society of the Plastics Industry, Inc. Value of products went up by $108-million. Since the industry first started compiling figures in 1922, it has established a production record in 31 of the 36 years, including the last six.

Corporate Changes and New Companies

In December, C. H. Dexter & Sons, Inc., Windsor Locks, Conn., assumed ownership of Standard Insulation Co. of East Rutherford, N. J., which it will operate as a subsidiary. Acquisition marks the paper and fiber firm's entry into the fields of lamination, coatings, and reinforced plastics.

Johns-Manville Corp. has formed a wholly-owned subsidiary, Johns-Manville Fiber Glass, Inc., which, in turn, will purchase the assets and business of L. O. F. Glass Fibers Co. One share of J-M common stock will be exchanged for each 2½ shares of L.O.F. common stock

A custom blending and compounding service called Poly-Blends is announced by Plastic Materials, Inc., Hicksville, N. Y., and Thermo Plastic Materials, Inc., Chicago, Ill. Designed specially for blow molders, Poly-Blends are said to combine the rigidity and heat resistance of high-density polyethylenes with the processing ease of the conventional materials. They can be used to advantage, too, by injection molders and extruders. A blow molding firm has been incorporated in Nashua, N. H.—Air-Formed Products Corp. Founded by H. I. Farnsworth and G. E. Pickering, men active in blow molding since its commercial introduction, the firm will contract for the blow molding of toys, housewares, and containers; and will design, manufacture, and sell equipment.

Grace to License Valve Gating

Agreement between W. R. Grace and Columbus Plastic Products, Inc., makes it possible for resin suppliers to obtain sub-licenses from Grace for the valve gating method of injection molding. The suppliers then, in turn, can offer the process to their customers on a licensee basis.

New Plants and Labs

Borden Chemical Co. has scheduled two plants for 1959 opening, and formally opened a $4-million addition to its PVC plant in Leominster, Mass. This new unit increases Borden's PVC capacity from 12 million to 38 million pounds per year. This expansion not only doubled the size of the former laboratory, but required a 100% increase in technical personnel. Construction is underway on a Borden coatings and adhesives plant in Illiopolis, Ill., which will replace the firm's Reslac operation in Chicago; plus a polyvinyl alcohol plant adjoining existing facilities at Leominster. The PVA plant will cost $1½-million, and will have a capacity of five million pounds annually.

Bel-Art Products, manufacturers of plastics fabrication equipment, has moved to new and larger quarters in Pequannock, N. J.

Interchemical Corp. has opened a color center in New York City for basic research, consultation, and information in that field. Director is F. L. Wurzburg, Jr., who has been associated with color for 25 years. Work will be done on improved techniques for color matching and better methods for establishing color standards and tolerances.

Melamine Dinnerware Promotion

An interesting campaign for promoting Melmac dinnerware paid off for American Cyanamid Co. recently. Called the Melmac Sweepstakes, the campaign ran from September through October, and offered 81 prizes of $50, $100, and $500 to some 8,000 restaurant equipment salesmen. Prize certificates, sealed in envelopes, were placed with selected buyers for top restaurants, hotels, schools, hospitals, and other institutions throughout the country through the facilities of the National Advertising Agency Network.

Salesmen who promoted Melmac to a buyer holding one of the prize certificates was automatically a winner. In addition, that buyer received a gift of Melmac for personal use. Specific aims and results of the program were the expanding of institutional markets for Melmac dinnerware, the generating of sales enthusiasm, the aiding of Melmac molders to enter new markets, and the creation of a buying demand.

Reichhold Builds In Midwest

L. Chris Brandt, general manager of Reichhold Chemicals' Kansas City, Kan. division, has announced that the company's seventh U.S. formaldehyde producing plant is being erected in that city with production scheduled to commence in April 1959. The project will cost about a half-million dollars, and will be capable of 30-million pounds annual output.

Reichhold also is installing a methanol terminal station which, in addition to supplying its own needs, will be used to service other users in the Kansas City area. Source-point for this raw material is Reichhold's methanol plant in Pensacola, Fla., from where the product will be shipped by river barge.

Polyethylene Milk-Vending Bag

Bulk vending of milk is now practical, thanks to polyethylene. A new mechanism, called the Cup-O-Matic, has been developed by Food Engineering Corp., incorporating a Bakelite polyethylene sack within the clamp mechanisms of the vending machine. Before use, the bag is sterilized electronically and placed onto the bottom outlet of the dairy can. At the machine, it is unfolded and inserted within the clamps. This disposable packaging has obviated the need for tubes, valves, and pressure pumps in milk dispensers.

Isochem Appoints Sales Rep

Isochem Resins Corp., Providence, R. I., has appointed Mechelec Sales Co., Medford, N.J. as its mid-Atlantic sales representative. This territory includes southern New Jersey, Delaware, Maryland, District of Columbia, and eastern Pennsylvania. Under chief sales engineer Edward Penberthy, Mechelec will handle Isochem's entire line of epoxy and polyester coating, potting, and casting resins, epoxy adhesives, as well as the companion line of Isoterge and Isostrip clean-up and stripping agents.

Montecatini-Ziegler Statement

This joint statement, released by Montecatini and Prof. Ziegler, is intended to complete the statement contained in a letter of the Head of the Planning and Development Division of Montecatini to the editor of "Rubber and Plastics Age" published in the November 1958 issue of said British magazine, as well as a similar statement released to the U. S. press on November 16, 1958 on the occasion of the opening of the 8th National Plastics Exposition.

"According to an existing Montecatini-Ziegler agreement, Ziegler has exclusive rights on Polypropylene in Germany and Montecatini has exclusive rights on Polypropylene in Italy. Montecatini's and Ziegler's patent rights outside Italy and Germany are licensed by Montecatini according to said Montecatini-Ziegler agreement.

"Montecatini negotiates patent licenses taking into consideration Ziegler's wishes, final decisions being reserved to Montecatini, which retains the major share of the returns.

"This agreement was reached after the following developments had taken place: Montecatini became in January 1953 one of the earliest licensees of Ziegler's pioneer developments on organometallic catalysts. Zigler's 1953 invention of new complex organ metallic catalysts and of the possibility of polymerizing ethylene to high polymers with the aid of them was disclosed to Montecatini in December 1953. Shortly after this disclosure, Prof. Natta, Montecatini's consultant, working with Ziegler-type catalysts, succeeded in discovering sterically differentiated polypropylenes and somewhat later he discovered stereospecific catalysts and invented his stereospecific propylene polymerization processes.

"Hercules and the four other U. S. companies which have acquired licenses from Ziegler prior to the Montecatini-Ziegler agreement (which licenses do not entail any rights on Montecatini's patent rights) have not yet acquired Montecatini's patent rights on Polypropylene."

Composite-Laminate Nose Cone

As a result of considerable research, Taylor Fibre Co., Norristown, Pa., has come up with a composite laminate which appears to be the best material for missile nose cones. Made by alternating layers of asbestos mat impregnated with a special phenolic resin and a nylon fabric material impregnated with the same phenolic, the laminate is commercially available as Grade HT-5000.

Tests showed that at five minutes (which exceeds the maximum time a missile is subject to atmospheric friction on re-entry) this new material conducts about 25%

Military-Federal Specs

A qualified products list is being prepared for the following military and federal specifications: MIL-I-14511, Insulation Sheet, Cellular, Plastic; Thermal. MIL-P-14591, Plastic Film; Non-Rigid, Transparent. These specifications will require prior qualification testing of the material, and manufacturers are urged to take prompt action concerning qualification testing of the products they wish to offer for government procurement. Information can be obtained from the Commanding Officer, Picatinny Arsenal, Dover, N. J.; Attention—Plastics and Adhesives Laboratory.

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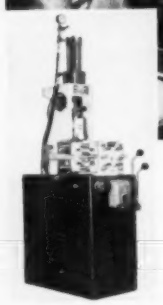

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less heat from the surface to the interior than the most effective homogeneous material tested to date. Surface temperature was 2,000° F.—about the temperature generated by missile re-entry.

Other possible uses for the laminate include; liners for propellant chambers in missiles, oil industry applications, and anywhere that temperatures in excess of 500° F. are encountered. The superior thermal insulation attributed to HT-5000 is said to be due to the lower density of the impregnated nylon layers. Nylon also carbonizes, making the material erosion resistant. Nylon alone, however, burns.

Marlex Surgical Mesh

Phillips' high-density polyethylene, Marlex, has been used successfully in the repair of tissue defects of the chest and abdominal wall. Used in the form of surgical mesh, the material fulfilled all the requirements of an inert plastic prosthesis which would set up very little foreign-body reaction. Francis C. Usher, associate professor of clinical surgery at Baylor University, Houston, Tex., exhibited the material and findings at the meeting of the American College of Surgeons, held in Chicago on October 6-10.

The mesh was used on 53 patients with large incisional or inguinal hernias. In no instance, according to Dr. Usher, was it necessary to remove the prosthesis. The mesh was used also in six patients to replace large tissue defects resulting from the excision of tumors. Here, a firm but pliable fibrous tissue replacement was obtained.

Epoxy Tooling Seminars

Ren Plastics, Inc., Lansing, Mich., has scheduled a year-long series of epoxy tooling seminars which will be presented to users and potential users in major U.S. cities. Sessions will be held in Chicago, New York, Dallas, Milwaukee, Philadelphia, Cleveland, Boston, St. Louis, Buffalo, Pittsburgh, and Cincinnati, followed by a tour of the west coast later in the year.

Of one-day duration, the seminars will be opened with a 30-minute slide film which describes plastics tooling, its limitations and future possibilities, Physical characteristics of pertinent plastics will be discussed, as well as the economies which can be achieved through their use. Various phases of a plastic tool department's operations will be explained in a brief lecture which also will cover the role of the tool engineer, the design engineer, types of personnel required, and approximate methods of cost-estimating. A 10-minute motion picture, depicting Ren's particular operations, will be followed by demonstrations of the actual building of plastic tooling by laminating, surface casting, mass casting, and splining.

Sommers Enters New Quarters

Sommers Plastic Products Co. has opened what is reputed to be the country's largest distribution center for vinyls and vinyl-coated fabrics at East Rutherford Industrial Park, East Rutherford, N. J. Executive offices will be located at this address also. The firm will continue to maintain a showroom at 330 Fifth Ave., New York City.

Forms U.S. Sales Company

Vereinigte Ultramarin Fabriken, A.G., Cologne, Germany, has formed a U.S. corporation to handle its product-sales in this country. Known as United Ultramarine & Chemical Co., Inc., the firm maintains executive offices at 149 Broadway, New York, N. Y., and will handle the full range of Ultramarine Blue pigments manufactured by the parent company. Otto C. Leverkus, managing director of Vereinigte Ultramarin, has been named president of the new corporation, and William F. Siemon, Jr., executive vice president.

Ups Diisocyanate Capacity

Expanding urethane product-markets have dictated a 50% capacity increase for tolylene diisocyanate chemicals at Mobay Chemical Co.'s New Martinsville, W. Va. plant, according to J. R. Eck, president of that firm. This addition, coupled with the multi-purpose facilities completed in 1957, forms what is believed to be this country's most complete and diversified single facility for the manufacture of basic urethane chemicals. Mobay is jointly owned by Monsanto Chemical Co., St. Louis, Mo., and Farbenfabriken-Bayer, A.G., Germany.

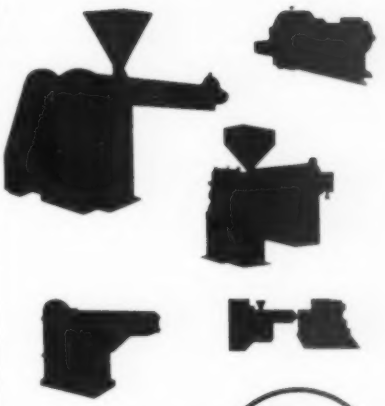
Catalin Opens Chicago Office

A Midwest regional sales office has been established in Chicago by Catalin Corp. of America. Located at 221 North LaSalle St., the office will serve as headquarters for all salesmen in the area from Ohio to the Rocky Mountains. Catalin plants are located at Fords, N. J.; Calumet City, Ill.; and Thomasville, N. C.

NEWS FROM ABROAD

New Dutch Joint Sales

The Algemene Kunstzijde Unie N. V., Arnhem, and the States Mines Limburg, are shortly to establish a joint sales organization for plastics, to be known as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Verenigd Plastic Verkoopkantoor N. V., with headquarters in Zeist, The Netherlands. The new company will sell the Akulon nylon materials of Algemene Kunstzijde, and Stamylan (the polyethylene produced by States Mines) both at home and abroad. It also will set up a laboratory for research on applications and technical services.

This combination of forces of two leading Netherlands chemical companies is apparently due largely to the desire to strengthen the position of the Netherlands in the coming Euromarket and, as such, is seen as a welcome development here.

Polypropylene in Britain

Shell Chemical Co., Ltd., London, announces that as a result of continued development in the polyolefine field, it now is able to add polypropylene to its range of Carlona brand products. A limited quantity of the polypropylene now can be made available for evaluation in the injection molding field. Thus, the plastics industry in Britain now will have the opportunity of examining this material for the first time.

Phosphonitrilic Chloride Polymers

The demand in recent years for high temperature-resistant materials for rocket application has turned the attention of research chemists to the phosphonitrilic series of inorganic polymers. It is of interest, therefore, to learn that chemists studying the nature and properties of phosphonitrilic chlorides at the laboratories of Albright & Wilson, Ltd., London, England, have succeeded in developing a commercially practicable method of separating the trimer and tetramer from the crude mixture of cyclic and linear polymers. Sample quantities of pure trimer and tetramer have now become available, and larger quantities will be obtainable before long.

New Belgian Companies

The Union Chimique Belge recently participated in the establishment of two new companies connected with the plastics industry. S. A. Plastic Benelux, set up jointly with Société Eternit, will be devoted chiefly to the manufacture of sheet and moldings of reinforced plastics. S. A. Argus Chemical N. V., formed together with the American company (Argus Chemical Co.,) will exploit in Europe the American firm's processes in the field of special stabilizers and plasticizers.

Behind the Satellite Curtain

Czechoslovakia Makes Progress

Czechoslovakia's plastics industry has made great strides in the post-war period, and production is said to have increased by 460% in the 1948-1957 period. Phenoplastics, aminoplastics, PVC, polyamide, cellulose derivatives and, recently, PTFE also are being made. Output of PVC molding powder has risen steadily from 2,300 tons in 1953, to 2,600 tons in 1954, 3,000 tons in 1955, and 3,400 tons in 1956.

Hungary's Plastics Production

About 5,000 tons of plastics materials were produced in Hungary in 1957, an amount that is to be increased to 11,000-12,000 tons by 1960, according to plans. A pipe-line carries natural gas from Rumania for the production of PVC and acrylonitrile by the Hungarian Chemical Combine. Polyethylene production was started in a pilot plant in 1957; a Soviet process being used.

Poland's Plastics Program

Latest news about expansion plans for Poland's chemical industry reveals that some 3,300 billion zloty were allotted in 1958 to provide for a 15%-increase in production. New plants for plastics, synthetic rubber and synthetic fibers already are operating, including the PVC plant at Auschwitz where output is expected to reach 4,500 tons for 1958, and 14,000 tons by 1960. Originally, it was hoped to produce 6,000 tons in 1958, but the target for 1960 was 13,000 tons.

Present plans aim at a total output of 50,000 tons for all plastics by 1960; the totals had been 11,000 tons in 1955, and 22,000 tons in 1956. A 100% increase over 1960 production is looked for by 1970, to include 40,000 tons of PVC, 30,000 tons of polystyrene, and 20,000 tons of polyethylene.

Developments in Japan

According to recent press reports, Kunoshima Chemical Co., Hiroshima, is to produce polycarbonate resins on a commercial scale in 1959. The firm, which has been making the material on a laboratory scale, intends to build a plant with a daily capacity of five tons. Polycarbonate film will be made in a technical tie-up with the Eastman Chemical Co., (U. S. A.).

Asahi Dow, one of the two firms manufacturing polystyrene in Japan, is having difficulty in obtaining Japanese Government authorization to import the 18,000 tons of styrene monomer which it will require to carry out production plans until its plant, now under construction in Kawasaki, on Tokyo Bay, is ready to start operating in 1960. The government reportedly will permit the importation of not more than 12,500 tons of styrene monomer.

Asahi Dow has a technical arrangement with Dow Chemical Co., Midland, Mich., for the production of styrene monomer according to Dow methods. Annual output of 18,000 tons is planned, of which 14,700 tons will be polymerized to polystyrenes; 2,500 tons will go to Japanese Geon for use in synthetic rubber production; and the rest is to be sold to manufacturers of paint, polyester, and ion-exchanges resins.

The government's stand on imports of styrene monomer appears to be dictated by the fact that the Yokkaichi plant of Mitsubishi Petrochemical Co. is expected to begin producing styrene monomer in February 1959, also at the rate of 18,000 tons annually. The affiliated company, Mitsubishi Monsanto Ltd., of Tokyo, which has been making 300 tons of polystyrene monthly, is to double its capacity, and is said even to be preparing for still further expansion. Asahi Dow and Mitsubishi Monsanto, together, produced about 8,200 tons of polystyrene in 1957; the share of the former having been 5,500 tons, and of the latter, 2,700 tons. According to revised targets of Japan's five-year production plan for plastics, 1958 output of polystyrene should be 14,000 tons.

A recent government regulation reportedly requires the adoption of the metric system for all weights and measures. The vinyl sheet manufacturers are said to have started using this system, as of August 1, 1958, for sheet measurements, but it is not clear whether metric tons are involved in the above figures.

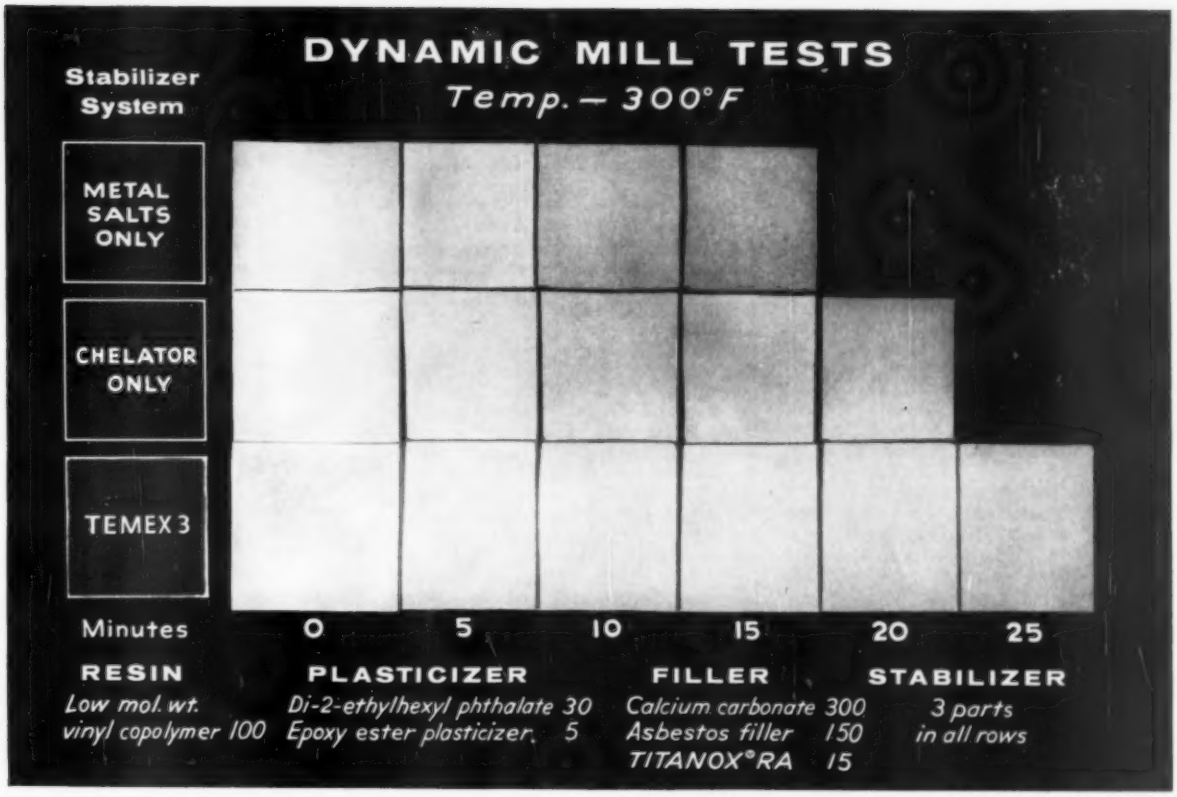
Progress at Grangemouth

In October 1958, building was started on British Hydrocarbon Chemicals' third ethylene plant at Grangemouth. This plant, with a rated capacity of 70,000 tons per year, will be the largest of its kind outside the United States when it is completed in 1960. The new plant will cost £6,000,000. Earlier construction had been undertaken also on phenol plant and a new polyethylene plant which are expected to be ready to operate in 1959.

It is estimated that by the time all these projects are completed, British Hydrocarbon Chemicals Ltd. will have invested a total of more than £30,000,000 on its petrochemical program.

Plastics and Radiation

At the Swedish Cancer Institute, Radiumhemmet, Stockholm, models representing three human heads, two torsos, and one uterus, employing plastic in their construction, are being used in investigations to measure the strength and effect of X-rays and gamma rays from a Cobalt-60 source. The heads and torsos are built up of tissues largely of plastic over real human skeletons, while the lungs consist of a kind of saw-dust. The models are of normal, human size, and are perforated internally at various points by fine channels.



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News of the Societies

SPE Philadelphia RETEC

SPE's Philadelphia Section RETEC, held November 6, 1958, at the Sheraton Hotel in Philadelphia, featured six technical papers under the general topic of "Advance in Injection Molding." The morning session was moderated by Charles W. Kleiderer, Penn Plastics Corp.; the afternoon, by W. J. B. Stokes, III, Electromold Corp. A guest speaker, Logan B. Cowles, General Electric Co., addressed the conference luncheon on "Problems of Space Travel."

Gustav G. Freygang and R. T. Cassidy, Rohm & Haas Co. discussed "Performance Characteristics of Three Designs of Heating Cylinders." Two recently developed cylinders were compared with a rather early design of a 16-ounce cylinder produced by Watson-Stillman. This unit was equipped with a conventional spreader but had no torpedo heater. One of the newer cylinders tested was a 16-ounce Superheater, manufactured by Injection Molders Supply. This, too, has a heaterless torpedo but has a larger diameter to provide greater heat exchange surface. The second design tested was a Polyliner, which is patterned after a cylinder orginially developed by Du Pont. In this model, the diameter is increased also, and a perforated spreader is used to segregate the plasticized material from the unheated granules as they move forward through the cylinder. The test method used was developed by Beyer and Dahl, of Dow Chemical Co.

"Injection Ram Speed Control in the Molding Processes" was considered by Gordon B. Lankton, E. I. du Pont de Nemours and Co. Mr. Lankton described an effort to control the polymer filling pattern through the study of three molding variables, namely: pressure, cylinder temperature, and ram speed. Data were gathered from an eight-ounce, Reed-Prentice molding machine using Zytel nylon molding powder. The machine and mold were instrumented to provide a continuous, simultaneous, record of hydraulic injection pressure, injection ram velocity, and pressure in the mold at the sprue puller as well as at a point most distant from the sprue. It was found that variations in ram speed were of lesser importance in their effect on the filling pattern than were cylinder temperature and injection pressure.

Gordon Cooper, International Vulcanizing Corp., discussed "Low Pressure Injection Molding." This form of molding, which is more appropriately called extrusion molding in this country, combines an extruder which plasticates the resin prior to its discharge into the mold. Use of an extruder in this fashion makes the material more uniformly homogeneous by the time of discharge. The machine considered was a Foster Wucher, four-inch, high speed extruder to whose nozzle 10 heavy duty mold carriers, situated on a rotary table, are indexed. Behaviour characteristics of this machine were discussed, as well as modifications which may be incorporated to enable it to fill molds adequately with thin wall sections.

Byron W. Nelson, National Cash Register Co., spoke on "Engineering of Injection Molded Parts in Business Machines." He pointed out that in the business machine industry, many different materials play small but highly important roles in the efficient functioning of the end-product. After analysing part function, design, material assignment, and tryout, the production planning and tooling phase becomes of prime importance.

"Pre-Compressed Injection Molding Technique" was explained by Albert Spaak, W. R. Grace & Co. He discussed the several methods and materials with which valve gating might be most efficiently utilized, and explained how this device can be incorporated into the mold design.

SPE New York Section

Officers of the New York Section, Society of Plastics Engineers, Inc., have been announced as follows: president, Herbert Weber, Rotuba Extruders and Waljohn Plastics; vice presidents, Edward Larkin, Monsanto Chemical Co., and Arnold Meyer, Union Carbide Plastics Co.; secretary, George O'Brien, U. S. Industrial Chemicals Corp.; and treasurer, James Dugan. PLASTICS TECHNOLOGY.

SPE Baltimore-Washington

The Baltimore-Washington Section Society of Plastics Engineers, Inc., held a roundtable discussion on January 13 at the Hot Shoppe, Langley Park, Md. Topic under discussion was "The Role of Chemical Finishes for Glass Fibers in Reinforced Plastics," moderated by H. A. Perry, Naval Ordnance Laboratory.

Panel members were Professor John Rutzler, Case Institute; Professor F. J. McGarry, Massachusetts Institute of Technology; M. A. Jellinek, Silicones division, Union Carbide Corp.; and George Stein, A. O. Smith Corp. Subject matter covered included the chemical and physical mechanisms involved in the deposition of finishing agents on fibers, the role of finishes in protecting fibers from natural and industrial atmospheric conditions, factors governing rate and completeness of fiber wetting by resins, effect of finishes on curing rate of resins, and the influence of finishes on adhesion.

SPE Buffalo Section

A. R. Morse, Injection Molders Supply Co., discussed recent developments in heating cylinder design at the November 7th meeting of SPE's Buffalo section. He stressed the need for balanced heats and proper molding cycles to avoid the production of defective commercial items. Also covered was the problem of entrapped gas and decomposition products found inside all heating cylinders. He described some of the results which can be obtained by venting these gases. This approach, while old to the extrusion industry, is entirely new in the injection field.

Reinforced Plastics Meeting

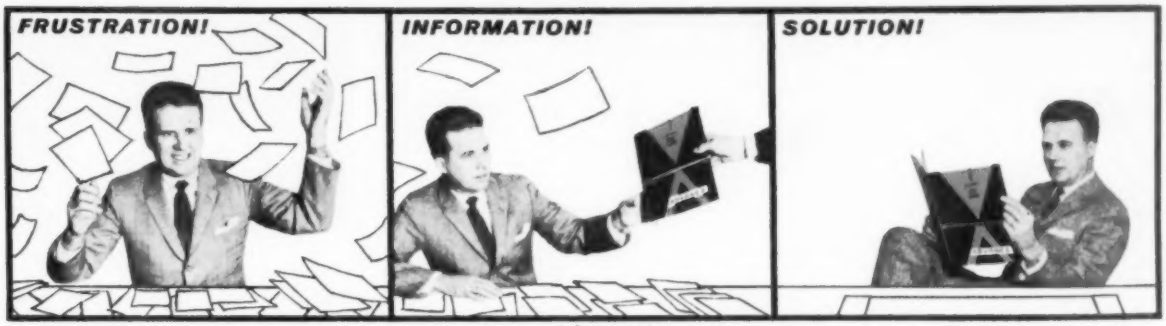
The 14th Annual Reinforced Plastics Conference, sponsored by the Society of the Plastics Industry, Inc., is scheduled for February 3-5 at the Edgewater Beach Hotel, Chicago, Ill. Announcement was made as to the general program last month in the column, and here we wish to state only that it is not too late for advance registration. Information can be secured from the Society's offices at 250 Park Ave., New York City.

SPE 15th Annual Conference

Program for the 15th Annual Technical Conference of The Society of Plastics Engineers, Inc., is both interesting and varied. Scheduled for presentation January 27-30 at New York City's Hotel Commodore, it will feature 26 sections on the following subjects: Latest Developments in Stereospecific Polymers, Topics of Special Interest, Thermoforming, Extrusion (2 sessions), Injection Molding (2 sessions), Educational Symposium, Plastics in High-Temperature Electrical Insulation, Aesthetic Aspects of Plastics, Vinyls, Mold Design (2 sessions), Reinforced Plastics (2 sessions), Blow Molding, Printed Circuits, Plastics in Buildings, Test Methods, Cellular Plastics-Foams, Epoxy Resins, Plastic Packaging, New Materials, Adhesion and Adhesives, Permanence Properties, and Compression Molding.

Three simultaneous sessions will be held most mornings and afternoons; however, the program is so scheduled that there will be a minumum of times the average attendee might wish to attend simultaneous sessions. The annual business meeting will be held during the Conference, and there will be two special luncheons and a banquet.

An attendance of over 3,000 is expected, and a number of experts are expected from abroad. Among the speakers carrying out the theme "Worldwide Advances in Plastics" will be Professor H. V. Kargin, vice president of the U.S.S.R. Academy of Sciences, and Professor Guilio Natta, Polytechnic Institute of Milan, Italy.



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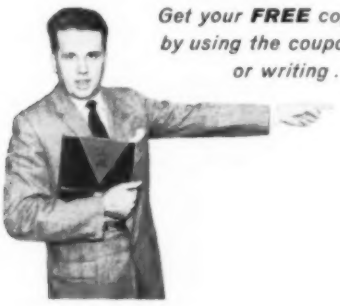

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Names in the News

Harry C. Byrne, Jr.

Harry C. Byrne, Jr., has been named Assistant to the Vice Pres., for the Plastics Division of Visking Company, Division of Union Carbide Corp., Chicago, Ill. He will function in a general administrative capacity. Mr. Byrne was formerly sales mgr., for the company's Eastern Div.

Walter P. Arnold has been elected an executive vice president of Koppers Co., Inc. He joined the firm in 1925, and has served the firm as vice president and general manager of the wood preserving division.

Irwin M. Rosenbaum has been appointed a technical sales representative for Geigy Industrial Chemicals, and will maintain headquarters in Philadelphia. He will represent the firm in Eastern Pennsylvania, Maryland, Delaware, and the Southeast.

Thomas A. Littmann has joined the plant engineering department of Monsanto Chemical Co.'s Plastics Div., Springfield, Mass. He previously served with the General Refractories Co.

Edward J. Geise, formerly sales manager of Vibrin polyester resins, has been appointed assistant manager of commodity sales for U.S. Rubber Co.'s Naugatuck Chemical division. His former post is being filled by **Robert P. White,** who had been technical sales representative for plastics in the Boston area. **Amico J. Lombardi** succeeds Mr. White.

Completing 35 years of service with Bakelite Co., **Dr. Howard L. Bender,** senior research associate, who in 1953 received the John Wesley Hyatt Award "for achievement of wide importance to the plastics industry," retired October 1. An alumnus of Marietta College, Case School of Applied Science, and Columbia University where he was granted a doctorate in chemical engineering, Dr. Bender's research efforts have contributed to improved manufacturing techniques where phenolic resins are used in laminating, bonding, adhesives, coatings, and molding compounds.

Edward G. Atkinson has been appointed eastern sales engineer of The Fiberite Corp., Winona, Minn. He will service custom molders in New England, New York and Pennsylvania. **Edward Keusch,** now located in Bloomfield, N. J., will continue to operate in a technical service capacity.

James R. Malone has joined Mobay Chemical Co., a jointly-owned associate company of Monsanto Chemical Co. and Farbenfabriken Bayer (of Germany). He will be midwest sales representative. He previously was a sales representative for Steelcote Mfg. Co., and a chemical formulator for the Carboline Company, both of St. Louis.

Jack H. Dollinger has been named president of Ferro Chemical Corporation, Bedford, Ohio, a subsidiary of Ferro Corporation, of Cleveland. He has been serving as general manager since November 1957, and in April 1958 was made vice president and appointed to the board of directors.

Monroe G. Smith has been elected a vice president of The Electric Storage Battery Co., of Philadelphia. He also is general manager of the company's Industrial Division and Jessall Plastics Division and will continue to direct the operations of the two divisions.

Louis H. Collins has been appointed plant manager for Flexible Products Co., Marietta, Ga. He formerly served as plant engineer at the Newman, Ga., plant of the Richardson Co.

Lloyd Adam has been elected vice president in charge of sales and administration for Erie Engine & Mfg. Co., Erie, Pa. He served as sales manager for the past 15 years. New chief engineer, **Ray Weller,** has 12 years experience in the design and development of plastic and rubber machinery. A third appointment at Erie finds Tom Kramer joining the firm as hydraulics and applications engineer.

Ray E. Weller

Lloyd Adam

Irving H. Schupp has been promoted to district sales manager for plastics products at the Argo, Ill., offices of Reichhold Chemicals, Inc., White Plains, N.Y. For the past five years he has been technical sales supervisor of the polyester resin department. His new duties will encompass the sales and promotion of polyester and epoxy resins as well as phenolic materials used for laminations, grinding wheels, moldings, and other applications. The Argo territory covers parts of Wisconsin, Michigan, Indiana and Illinois. **W. Arthur Weismann** has been advanced to sales promotion manager, in which capacity he will promote the sales of RCI products. These include industrial chemicals, plastic materials, surface coating resins, emulsions, industrial adhesives, chemical pigment colors, foundry products and paper making materials. He will work from the White Plains headquarters, but also will make frequent contacts with RCI customers throughout the country. For the past two years Mr. Weismann has been regional sales manager in the surface-coating resins department.

W. Arthur Weismann

OBITUARY

Barthold Ernest Schlesinger

Barthold Ernest Schlesinger, 82, founder and treasurer of Northern Industrial Chemical Co., died December 15, 1958, at his home in Chestnut Hill, Mass.

A graduate of Harvard College in 1898, and M.I.T. in 1901, Mr. Schlesinger was considered one of the pioneers of the plastics molding industry. He is survived by his wife, Gladys Anne Noyes, two sisters, and three step-children.

New Materials

Write item numbers on Readers' Service Card (p. 85) to obtain more information.

Silicone Laminate

A coarse-weave, continuous-filament, glass fabric bonded with a silicone laminating resin is being marketed under the tradename Dilecto GB-89S, by Continental-Diamond Fibre Corp. An economy grade, this laminate shows high heat, flame and arc resistance, as well as good electrical and mechanical properties.

Available in sheets or molded shapes, Dilecto GB-89S can be used as terminal, mounting, or spacer blocks in many electrical applications where temperatures up to 200° C. are encountered. Electrical properties include:

Dielectric strength, kv	60
Constant, 1 mc	4.0
Dissipation factor, 1 mc	0.0025
Loss factor, 1 mc	0.010
Surface resistance, megohms	2,000
Insulation resistance, megohms	5,000
Arc resistance, sec	200

These data were obtained from tests performed on ⅛-inch material. Mechanical properties, such as tensile, flexural, and compressive strengths and flammability are in excess of those determined for NEMA Grade G-7 Standard. This grade ranges from off-white to tan in color and is available with either a standard semi-gloss or special polished finish.

Readers' Service Item 1

Contact Cements

A series of contact cements known as Instant-Lok are being marketed in a wide range of specific adhesive characteristics by National Starch Products, Inc. Based on oil-resistant elastomers and synthetic resins dissolved in an organic solvent, these cements cure to a high peel strength bonds characterized by good resistance to fatigue, alchohol, gasoline, and most aliphatic hydrocarbon solvents. Weathering and aging properties are good and water resistance is excellent.

Most of the Instant-Lok cements can be dissolved in toluol or methyl ethyl ketone. They can be applied by hand, roll-coating equipment, or with a spray, after which they are air- or oven-dried. One gallon will cover an area of 120-220 square feet, depending on method of application and porosity of the surface.

Readers' Service Item 2

Fungicide For PVC

A fungicidal and fungistatic additive for PVC compounds is being marketed under the tradename Ottacide P, by Ottawa Chemical Co. Compatible with the usual plasticizers and stabilizers, this material presents no compounding problems whether in solution, fluxed compounds, or plastisols.

Ottacide P is a derivative of p-chlorometaxylenol. During mildew resistance tests which allowed a 14-day incubation in mixed spore suspensions, several readings under a stereo-microscope revealed no growth whatsoever. Both heat and light stability are good, and tensile strength losses in coated fabrics are less than one-third of those permited by Federal Specification CCC-T-191-b 5760.

Readers' Service Item 3

VANSTAY*

Vinyl heat and light stabilizers

Our trademark of 14 years standing came into being with VANSTAY L, the first nontoxic light stabilizer for Vinyls.

Today, the VANSTAY* line includes a number of materials developed to keep pace with Industry's demands for higher temperature Vinyl protection in process and in service.

Expanded research and technical service can be of immediate assistance in solving your Vinyl stabilization problems.

*U.S. Registered Trademark

R. T. Vanderbilt Co., Inc.

230 PARK AVENUE · NEW YORK 17, N. Y.

shipped from stock order now!

IMS Super Duty T-2D Drum Tumbler with disposable fiber drums in place. New model features special clutch and electric brake.

IMS Drum Tumblers are stocked in 5 different models

T-2
Popular Model 3/4 HP

Takes drums up to 33" high and in all diameters up to 22".

Capacity 75 to 100 lbs. Each Drum

Price complete $595.00

T-2A
Medium Duty 1 HP

Specifications same as Model T-2 except that 1 HP motor is supplied in place of ¾ HP.

Capacity 100 to 150 lbs. Each Drum

Price complete $673.50

T-2B
Heavy Duty 2 HP

Takes drums up to 37" high and in all diameters up to 23¼".

Capacity 250 to 300 lbs. Each Drum

Price complete $897.50

T-2C
Extra Heavy Duty 3 HP

Takes drums up to 43" high and in all diameters up to 24".

Capacity 350 to 400 lbs. Each Drum

Price complete $1285.00

T-2D
Super Duty 5 HP

Takes drums up to 45" high and in all diameters up to 24".

Capacity 450 to 500 lbs. Each Drum

Price complete $2650.00

Complete Parts List and Operating Instructions available on request.

INJECTION MOLDERS SUPPLY COMPANY

3514 LEE ROAD • WYoming 1-1424 • CLEVELAND 20, OHIO

Two Polymeric Plasticizers

Two polymeric plasticizers, showing excellent durability in primary applications as well as in blends with monomeric types, are being marketed by Allied Chemical Corp.'s plastics and coal chemicals division. Tradenamed Elastex 36-R and Elastex 37-R, both materials are clear, yellow liquids which give off the mild odor characteristic of polyester plasticizers.

Elastex 36-R is a general purpose, medium molecular weight plasticizer exhibiting outstanding resistance to extraction by aliphatic and aromatic hydrocarbons. It is recommended for use in upholstery sheeting, coated fabrics, wall covering, electrical tape, high-temperature wire insulation, and window channeling. A high molecular weight material, Elastex 37-R lends high-temperature resistance to resin compounds as well as rendering them impervious to kerosene, oil, and soapy water. Cable jackets, paper coatings, refrigerator gaskets, high temperature- and high humidity-resistant insulation, as well as upholstery sheeting are among the applications recommended for this material. Physical properties of these plasticizers include:

	Elastex 36-R	Elastex 37-R
Molecular weight	1,900	6,900
Color, Hellige, max.	5	3
Viscosity, 25° C., poises*	38	2,700
Surface tension, 25° C., dynes/cm.	39.1	50
Specific gravity	1.09	1.15
Pounds per gal., 68° F.	9.12	9.59
Refractive index	1.466	1.475
Weight loss, 72 hr., 82° C., %	0.129	0.035
2 hr., 175° C., %	0.544	0.155
Flash point, °F.	545	575
Fire point, °F.**	615	635
Water, wt.%	0.02	0.05
Acid number, mg. KOH/g.	8.20	8.54
Saponification number, mg. KOH/g.	518	597
Volume resistivity, ohm-cm.	5.6×10^{10}	3.8×10^{10}

* Brookfield
** Cleveland open cup.

Readers' Service Item 4

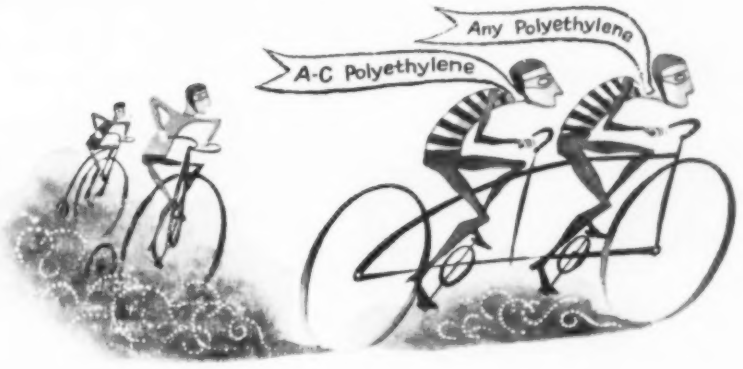
Odor Control for Butyrates

An oil-soluble, re-odorant for cellulose butyrate plastics which retains its masking characteristics under normal processing conditions, is being marketed under the tradename Alamask BMI, by Rhodia, Inc. While primarily designed for butyrate, this material can be added to plasticizers for incorporation into other resins. Amounts required vary from 0.05-0.1% by weight, depending upon the end-use to which the finished product will be put.

Where butyrates are handled as chemical wastes, a water dispersible form of this product is recommended. Application in this case can be made by adding a few ounces to 50 gallons of water, and spraying the mixture on the contaminated materials.

Readers' Service Item 5

Teamwork pays off!



For Faster Cycles . . . Holding Stress Crack Protection . . . *blend with*

A-C® Polyethylene

See the difference for yourself! Blend A-C Polyethylene with your regular polyethylene resins, particularly the lower melt indices. Here's what happens!

You mold the same parts at lower injection pressures, using faster cycles. Stress crack resistance of low melt index polyethylene in blend is protected by A-C Polyethylene. Rejects caused by poor color dispersion are reduced. Melt index of blend is changed to a desirable, workable melt viscosity for easy mold filling. Mold sticking problems are eliminated—*even with mirror-finish molds.*

And, you can cut inventory requirements! By modifying the amount of added A-C Polyethylene you tailor the resin melt index to meet each individual molding problem. High melt index resins are no longer required. With a few conventional polyethylenes plus A-C Polyethylene you can now do the job that formerly required many grades. Production costs are lower, quality of molded parts higher, and you stock fewer grades of polyethylene.

No special equipment is required to take advantage of A-C Polyethylene. Just add to your resin during the color blending operation. Find out how A-C Polyethylene can produce better molded pieces at lower cost *for you!* Telephone or write your nearest Semet-Solvay Petrochemical office today for full information.

Allied Chemical

SEMET-SOLVAY PETROCHEMICAL DIVISION
Dept. 551-R, 40 Rector Street, New York 6, N. Y.
National Distribution • Warehousing in Principal Cities

New Equipment

Write item numbers on Readers' Service Card (p. 85) to obtain more information.

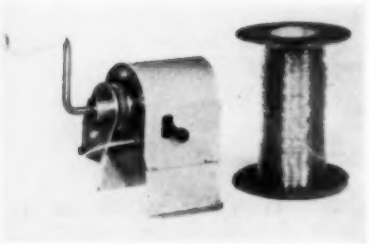
Patterson-Kelley solids flow valve.

Solids Flow Valve

A dust-tight, solids flow valve, for use with blending, milling, and conveying equipment where discharge of dry powders and granulation must be controlled has been added to the product line of Paterson-Kelley Co., Inc. Components are precision machined for complete interchangeability, and all parts including the neoprene body-liner can be replaced easily in the field.

The O-ring sealed shafts and vane are made of type 18-8 chromium-nickel, stainless steel. The valve is positioned by a discharge handle, and adjustments can be made for specific valve-openings. Available in 8-, 10-, and 12-inch sizes, the valves can be adapted for use with existing equipment, plastic bags, and vacuum vessels.

Readers' Service Item 21



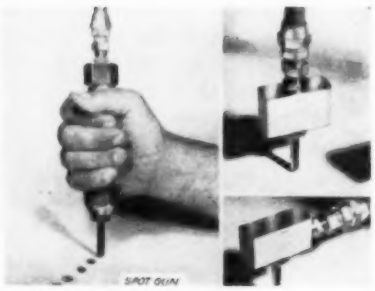
"Little Joe" sleeving cutter.

Sleeving Cutters

Sleeving cutters, designed to cut all types of insulation tubing up to ¼-inch diameter without crushing the stock, are being marketed under the tradename "Little Joe" by MacDonald & Co. Hand or electrically operated, these units feature a 4:1 gear ratio between the drive source and the cutter.

Tubing is fed through the machine, and cut pieces ranging in length from ¼-8 inches, are discharged automatically. The cutting blade is made of high speed tool steel, and all vital parts are case-hardened. "Little Joe" cutters are bench-type units, which can be anchored with two screws. Powered models have a 110-volt, 1/50th hp., Bodine motor. It operates at 115 rpm. and is protected by a 4-AG, two-amp. slow-blow fuse.

Readers' Service Item 22



At the left, the spot gun is shown in operation, while the insets at the right illustrate straight and angle flow designs.

Automatic Spot Glue Guns

A selection of automatic, air-operated, spot-glue, guns, which accurately position a circular film of glue on any flat hard surface have been added to the product line of John P. Fox Co., Inc. An extension of the firm's "FF" series equipment, these guns are available in a range of sizes which deposit glue spots ranging from ¼-1 inch in diameter.

Both manual and automatic types are available; the latter in a choice of straight or angle flow designs. "FF" units feature non-clogging design, high speed operation, and complete elimination of drippage and glue waste. They will handle all low-viscosity glues, as well as certain catalyst type adhesives. Operating air-pressures range up to 100 psi. Tank assemblies also are available in one-, 2½-, and five-gallon capacities. The tanks are glass-interlined and provided with a 10-foot air hose, one or more-10 foot fluid hoses (depending on the number of outlets specified), air regulator, air pressure gage and valve, gaskets, and fittings.

Readers' Service Item 23

X-acto industrial cutting knife.

Industrial Cutting Knives

Two recently-developed cutting knives, incorporating a knurled, easy-to-grip sliding sleeve which may be locked at any position on the knife barrel, have been introduced by X-acto, Inc. Made of heavy duty, machined aluminum, the sleeve may be moved back to reveal the entire blade, locked to expose any segment of it, or extended to cover it completely for carrying and storage safety. The blade, which is more cheaply replaced than sharpened, is locked into position with a knurled chuck. Known as X-acto 1-G and 2-G, these knives differ slightly in size to accommodate respectively, small or large blades.

Readers' Service Item 24

High Speed Die Grinders

Wilson high speed die grinder.

TINUVIN® P

protects against ultraviolet radiation

SUGGESTED APPLICATIONS

- Polyesters
- Polystyrene
- Acrylates
- Polyvinyl Chloride
- Polyvinylidene Chloride
- Polyvinyl Butyral
- Alkyds
- Polyamides
- Cellulose Esters
- Ethyl Cellulose
- Packaging Film
- Oil Extended Rubber
- Plastic and Silicone Coated Glass
- Synthetic Fibers

TINUVIN P (CH3457) is a new *Benzotriazole* Ultraviolet Absorber for protection of plastics and other products affected by actinic radiation. TINUVIN P combines superior light, heat and chemical stability with maximum ultraviolet absorption without yellowing. *(pat. appl.)*

Write for sample and data sheet today

GEIGY INDUSTRIAL CHEMICALS
DIVISION OF GEIGY CHEMICAL CORPORATION
SAW MILL RIVER ROAD • ARDSLEY, NEW YORK
Chicago Portland Houston Los Angeles Cincinnati New York

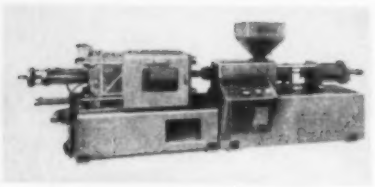
Pneumatic die grinders, with rated speeds of either 40,000 or 60,000 rpm., are being marketed in four models by Thomas C. Wilson, Inc. Featuring integral or remote exhausts, these units incorporate three-bladed air motors, air-cooled bearings, and a push-pull throttle for speed regulation.

The 40,000 rpm. models are provided with a ¼-inch collet chuck, while those of the 60,000 rpm. units are ⅛-inch. Design features of the cylinder, which is hardened, ground, and honed, include a finger tip rest and a chuck guard. A wrench and eight feet of air hose are provided as standard equipment. Recommended operating air-pressure: 90 psi.

Readers' Service Item 25

Extruder-Molder Combination

A combination extruder-injection molding machine known as Jetflo, has been developed and placed on the market by Package Machinery Co.'s Reed-Prentice Division. Capable of very high speed molding of thin sections and increased molding speeds on conventional items, this unit has produced stronger polystyrene containers, coffee cups, combs, etc., at cycles up to 50% faster than possible on conventional machines.



Reed Prentice Jetflo.

The Jetflo consists, essentially, of a 175-ton mold clamping mechanism and platens, coupled to a 100-pound per hour extruder. The extruder incorporates a hollow screw with an actuating plunger within the bore which always acts against plasticized material in the plunger cavity. This feature lowers injection pressure and results in faster plunger speeds.

Continuous speed control of the screw and plunger, together with an adjustable metering valve, provides accurate shot-control. The valve acts as a nozzle and holds back the flow of material so that it reaches maximum pressure before injection. A plunger adjustment permits operation with a minimum plunger movement, and electronic timers control all phases of the machine cycle.

Five proportioning-type pyrometers provide zone control of material temperature. The hydraulic system is a high-volume, low-pressure type, and the heat exchanger has a separate oil-recirculating pump. Single or dual nozzles can be accommodated on the stationary platen; changeover being simply a matter of removing or adding a twin-nozzle manifold which is available optionally.

A varidrive motor affords infinitely variable screw speeds, while a tachometer registers drive speed and a built-in safety device provides overload protection. Ejection failure causes the machine to stop and lights a flashing red warning light. Other characteristics of the Jetflo include:

Injection capacity, oz./shot	6
In.³/shot	10
Plasticizing capacity, lbs. /hr.	100
Hopper capacity, lbs.	150
Injection pressure, psi.	17,000
Total lbs.	28,270
Plunger stroke, in.	6
Speed, in./min.	360
Speed with optional equipment, in./min.	1,200
Mold clamping pressure, tons	175
Opening pressure, tons	4.5
Stroke, adj., in.	5-8
Thickness, max., in.	14
Min., in.	6
Size, max., in.*	22 x 13.5
Platen size, in.*	22 x 24.5
Space between tie bars, in*	13.5 x 13.5
Tie bar diameter, in.	3
Rated projected casting area, in.²**	75
Dry cycle time, min., sec.	1.3
Max., sec.	2.9
Pump motor, hp.	40
Vari-drive motor, hp.	5
Heater, KW	15.4
Oil reservoir cap., gal.	100
Machine weight, approx., lbs.	10,000
Dimensions (L x W x H), ft.	17.83 x 5.25 x 5.51

* Horizontal by vertical
** Dependent on product and mold construction

Readers' Service Item 26

Chop-Saw Attachment

A portable attachment which quickly

ANOTHER NEW IMPCO

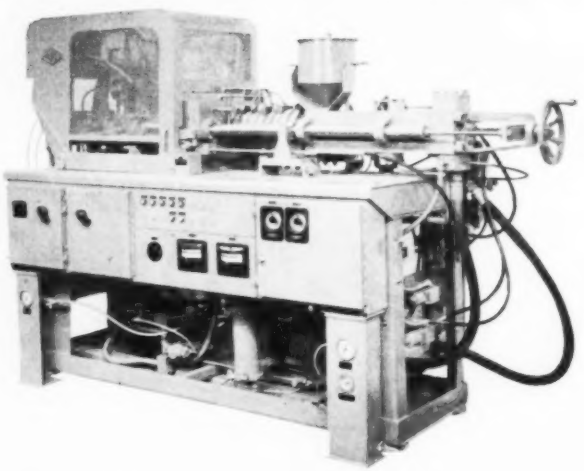
Special Purpose Injection Molding Machine for Containerlike Molding

MODEL

CA30-75

- 30-50 gram capacity
- 30 molding cycles per minute*
- shut-off nozzle for pre-pressurized molding
- simplified mold construction
- built-in die and platen cooling arrangement
- separate injection and clamp hydraulic circuits
- shock mounted control panel
- photo electric recycling monitor
- 75 ton clamp
- 9¼" stroke
- fully automatic

*dependent on material and mold construction



IMPCO IMPROVED MACHINERY INC.
NASHUA · NEW HAMPSHIRE

In Canada, Sherbrooke Machineries Limited, Sherbrooke, Quebec

"The resemblance to the real aircraft is remarkable!"

New Link Simulator Cockpit For Douglas Jetliner Built Economically

with RCI POLYLITE RESIN

Realistic surroundings help train air crews for tomorrow's jet transports. It is vital that conditions encountered in actual flight be simulated closely on the ground.

Even the exterior appearance of the training model should be lifelike. And the Link Aeronautical Corporation of Endicott, N. Y., which builds the cockpit for Link Aviation, Inc. in Binghamton, N. Y., has found that reinforced plastic construction utilizing RCI POLYLITE polyester resin now makes it possible to duplicate every outside detail accurately and economically.

Mr. Felix Aimonetti, Vice President and General Manager of Link Aeronautical states: "The use of POLYLITE polyester resin as a laminating agent helps make this Douglas DC-8 training cockpit a rigid, durable, realistic structure, with a surface that resists corrosion and is easily painted. Our experience with POLYLITE resin has continued to impress us with the high quality of laminating it performs."

If you think that RCI POLYLITE polyester resin can be incorporated in one of your products and wish information about its use in laminating, molding and other reinforced plastic applications, write for free Booklet B.

REICHHOLD

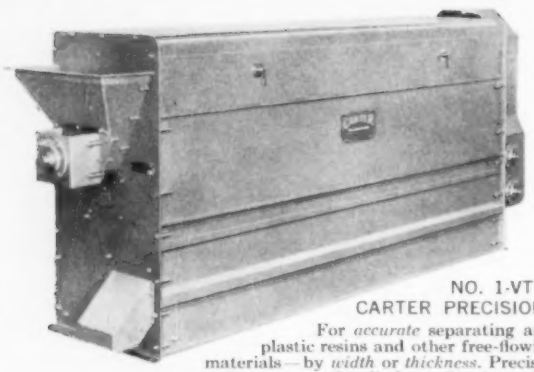
Synthetic Resins • Chemical Colors • Industrial Adhesives
Phenol • Hydrochloric Acid • Formaldehyde • Glycerine
Phthalic Anhydride • Maleic Anhydride • Sebacic Acid
Ortho-Phenylphenol • Sodium Sulfite • Pentaerythritol
Pentachlorophenol • Sodium Pentachlorophenol
Sulfuric Acid • Methanol

REICHHOLD CHEMICALS, INC.,
RCI BUILDING, WHITE PLAINS, N. Y.

RCI
Creative Chemistry... Your Partner in Progress

THESE SIMON-CARTER MACHINES
CAN STEP UP YOUR QUALITY CONTROL

Automatic separating and sizing of plastic pellets, dice and other shapes by length, width, or thickness.



NO. 1-VT
CARTER PRECISION GRADER

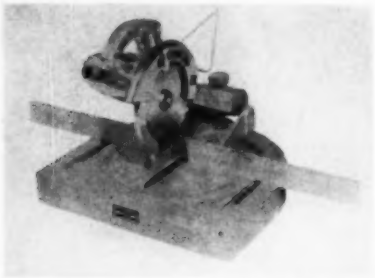
For *accurate* separating and sizing of plastic resins and other free-flowing granular materials—by *width* or *thickness*. Precision Graders separate by means of cylinders of unique designs with either round or slotted perforations. Various models and sizes—including multiple units—are available.

CARTER DISC SEPARATOR

For *accurate* separating and sizing by *length*. Carter Disc Separators vary in the number of discs and the size of the disc pockets. These pockets accurately lift material which is shorter, positively reject longer material. Laboratory demonstration tests are free.

WRITE TODAY for complete information, giving us a brief description of your sizing problem.

SC **SIMON-CARTER CO.**
677 19th Ave. N.E. Minneapolis 18, Minn. STerling 9-2417



CTD chop saw attachment used with a Porter-Cable electric hand saw.

converts an electric hand saw into a chop saw for plastics, non-ferrous metals, woods, rubbers, etc., has been developed by Commercial Tool & Die Corp. Made of heavily ribbed aluminum, this attachment swings on both sides of its centerline to make miter cuts from 0-45°. The 8¼-inch blade cuts two by 5¾ inches at 90°, or two by four inches on a 45° meter. A telescoping blade guard provides operator protection.

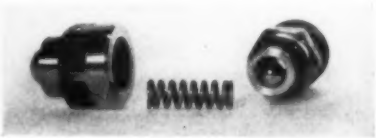
Attachment and saw can be carried to job sites, since their combined weight is but 36 pounds. In extended position, the base measures 18 by 34 inches. Over-all height is 15 inches. The attachment should both speed production and minimize material waste.

Readers' Service Item 27

Ball Shut-Off Nozzle

Injection Molders Supply Co. has introduced a ball shut-off nozzle with removable tip for the prevention of drooling or seepage of nylon. Called the IMS Model 3-4, the nozzle is especially useful on heating cylinders with front-mounted spreaders which tend to overheat the plastic just prior to injection. Conventional, reverse-taper nylon nozzles make it difficult to control drooling.

The inner springs are low in cost, and are easily changed in event of failure. Prices and specifications vary with the model and make of molding machine.



IMS anti-drool shut-off nozzle.

Readers' Service Item 28

Plastics Applications

Write item numbers on Readers' Service Card (p. 85) to obtain more information.

Glastic stand-off insulator.

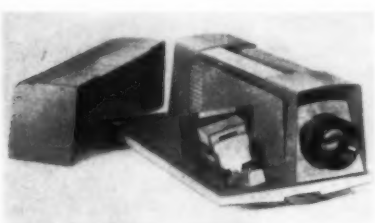
Polyester Insulator

A stand-off insulator, molded from fiber glass-reinforced polyester, is being marketed by Glastic Corp. for bus, contactor, and switch-support work. Labeled Part No. 1461, this insulator will not chip during assembly or when exposed to short-circuit surge shocks. It is made from Glastic UMG compound which is approved by Underwriter's Laboratories for support of current-carrying parts operating in the 150° C. temperature range.

Readers' Service Item 41

Semi-Automatic Projector

A semi-automatic slide projector whose housing is molded from Phillips Chemical Co.'s Marlex high density polyethylene, is being marketed under the trade-name Opta-Matic, by Optics Mfg. Corp. Illuminated by a 300-watt lamp, this projector incorporates an aspherical condenser lens system which gives corner-to-corner illumination and image sharpness to 35 mm., 127 Super, and 828 Bantam slides. The four-inch Optacor f3.5 coated projection lens is claimed to transmit a brightness equivalent to many 500-watt systems.



Opta-Matic Slide Projector.

Colored Riviera blue, Opta-Matic is equipped with a powerful blower and a new vent system which maintains air circulation at all critical points of the projector including both front and back of the slide seat. Out-of-focus popping, caused by heat-buckled transparencies, thus is eliminated since the temperature will not exceed 85.2° F. when the room is at 72°.

The lamp can be changed externally, and a Ready-matic changer provides 36-slide, finger-tip operation. Weight of the entire unit is slightly over six pounds. The Marlex casing, which is guaranteed for life, was molded by Auburn Plastics Inc., using a Standard Tool and Die Co.-designed mold.

Readers' Service Item 42

Unsupported Plastic Films

Several unsupported thermoplastic films have been developed by Ludlow Papers, Inc., using that firm's new Flex-L manufacturing process. This process is said to impart superior clarity and gloss to all thermoplastic films, orient their molecular structures, form products at optimum crystallinity, and convert polyethylene to clear, glossy film.

Proplene is a high-gloss packaging film made from Hercules' Pro-fax polypropylene, and results would indicate that this material will offer considerable competition to the polymerized cellophanes, Saran, the medium and higher density polyethylenes, and some vinyls. It can be used with overwrap and bag impluse-sealing machines, and also performs well in blister and skin-type packaging. Other plus factors are good printability and exceptional shelf life.

Caplene is a caprolacam-based film made from Spencer's nylon-6. Expected to offer competition to polyester films, Caplene can be heat-sealed, printed, is self-extinguishing, and has excellent resistance to greases, solvents, and alkalis. It can be boiled, sterilized, or autoclaved.

Orthofoam and Metafoam are made from low- and medium-density polyethylene, respectively. Flexible, textured sheeting, they can be thermoformed into endless numbers of attractive packages. Their insulation and moisture-barrier values indicate that they will compete with foil, plastic laminates, and higher grades of paperboard. Both are available in rolls or sheets, either natural or colored.

Ludlow's Caplene nylon-6 film has outstanding strength and clarity.

Three other new Ludlow products are high-, medium-, and low-density polyethylene films known respectively as Paraplene, Metaplene, and Orthoplene. These films are said to have unusual clarity and gloss.

Readers' Service Item 43

Epoxy-Mica Insulation

Combining epoxy resin binders with reconstituted mica, Minnesota Mining and

Typical Isomica-Epoxy products.

Mfg. Co.'s Mica Insulator Division, has produced a micaceous insulation for use with Class B electrical equipment. Designated Isomica-Epoxy, this material exhibits high electrical properties, good mechanical strength, outstanding heat and chemical resistance, and extreme uniformity in thin sections.

Isomica-Epoxy insulation is available in rigid and flexible forms, and with a semi- or fully-cured binder. Rigid forms include segment plates, molding plate, and tubes; while the flexible forms include slot liners, sheets, tapes, and combinations. Molded V-rings, used in commutator insulation, also are available. These are made with regular mica splittings which provide the stretch necessary during assembly operations.

The semi-cured group, used where electrical insulating components are hot pressed, can be through-cured at a cycle of two hours at 150° C. The insulation bonds into a solid, homogeneous mass which has high corona starting levels and good dielectric properties. Moisture resistance is high and the material is relatively inert to transformer oils, chemicals, and solvents.

Readers' Service Item 44

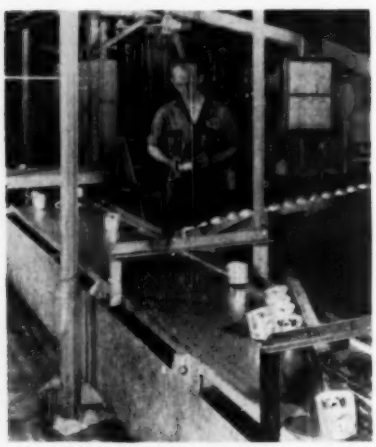
Heavy-Industrial Vinyl Belt

Not even freshly-cast, razor-edged aluminum pistons dripping with harsh cutting oils affect the new "heavy industrial" Koroseal belt made by B. F. Goodrich Industrial Products Co. The pioneer installation was at Ford Motor Co.'s No. 1 engine plant in Cleveland.

Outlasting all formerly-used belts by more than two-to-one, the belt operates as a "pan" conveyor, without idlers, to convey castings from rough machining to finish machining and inspection. Whereas old belts were continuously begrimed, and fouled the locating hole within the piston boss, the new Koroseal belt is wiped clean instantly with a dry cloth.

Ford's piston castings, as designed, ride the belt while touching at only two points; yet, the Koroseal belt has no difficulty conveying these pistons up a 30-degree incline. More than 1,500 feet of the belting are being used on 11 lines at the plant, measuring in width to 24 inches and in lengths from 47-310 feet. They are reinforced with 2-4 plies of 42-ounce fabric.

Readers' Service Item 45



Koroseal belt in operation at Ford plant.

Pressure-sensitive urethane tape, tissue-backed.

Urethane-Foam Insulation Tape

A urethane-foam tape backed by a pressure-sensitive adhesive (protected by tissue) has been introduced by United Mineral & Chemical Corp., under the tradename Tesamoll. Available in rolls of ¼- and ⅜-inch widths, the tape insulates against heat, cold, noise, and vibration. Waterproof and chemical resistant, Tesamoll is only about ⅛ the weight of rubber.

The tape is marketed in cream white, green, gray, brown, and black, and can be obtained in widths wider than those listed above—to specification. Suggested industrial applications include the mounting of radio and electronic speakers, the protection of TV sets against dust, sealing gasketing, and lining and cushioning of furniture drawers.

Readers' Service Item 46

Polyethylene Barbells

Young muscle-builders now can work out with Powerarm barbells, which incorporate hollow weights made of Eastman Chemical's Tenite polyethylene. Manufactured by Mattel, Inc., the basic barbell consists of a 32-inch aluminum bar with two eight-inch weights and four 5⅜-inch weights for each end.

The weights are hollow and can be filled with water, dry sand, or wet sand to adjust the weight between 2-20 pounds. Red end-locks, also of polyethylene, snap into holes in the bar on both sides of the weights to hold them in place firmly. A plug on the inside face of each weight may be unscrewed to permit easy filling. Short dumbbell bars, using the same weights, also are available, and the manufacturer supplies instructions along with a table of weights and an excerise chart.

Readers' Service Item 47

Powerarms and the Boy.

Throw-Away Electrolyte Pack

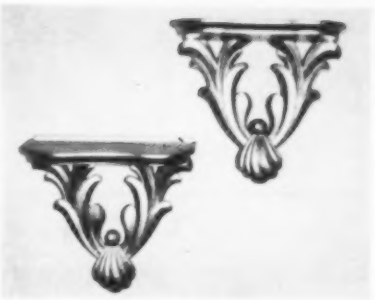
A five-gallon, throw-away container for Du Pont electrolyte has been introduced by that firm's Grasselli Chemicals department. Called the Cubitainer, it consists of a rigid box-board container with liner of Du Pont Alathon 14 polyethylene. A probe dispenser, the flow through which can be regulated by a hand clamp, is inserted directly through box and liner. Polyethylene's plastic memory causes it to clamp tightly about the probe, thus allowing the contents to be metered

Disposable electrolyte pack features self-sealing polyethylene liner. A probe is inserted through wall and liner, and contents are metered into battery.

out without leakage.

The container was developed by the Hedwin Corp., who first displayed it at the National Packaging Show earlier this year. Alathon 14 has a density of 0.914, a melt index of 1.8, and is noted for its toughness and flexibility. The liner is made in two halves which are sealed together and shaped by vacuum forming. The finished liner readily folds as the liquid contents are discharged, permitting even flow without burbling. Probes and clamps are reusable.

Readers' Service Item 48



Polystyrene wall bracket.

Readers' Service Item 50

Universal Grade Micarta saves post-forming costs on counters and sink-tops.

Readers' Service Item 51

Borden's nylon-reinforced vinyl hose.

Nylon-Reinforced Vinyl Hose

Borden Co. has made available a vinyl garden hose of heavier wall thickness, reinforced with braided nylon. Reported to withstand the highest residential pressures, this Resinite Gold Stripe reinforced hose is equipped with solid brass ShurLok couplings. It is extremely flexible, and is easy to coil even at low temperatures.

Readers' Service Item 49

Plastic Wall Bracket

A decorative design in plastic wall brackets featuring a slotted shelf which enables users to display their most delicate items with absolute safety, is being marketed by Victory Mfg. Co. Especially appropriate for china, bric-a-brac, and numerous other ornamental articles, these brackets are gold colored, made of polystyrene, have a three by six inch top-area, and are seven inches high.

Universal Grade Micarta

Westinghouse Electric Corp. has developed a "Universal Grade" Micarta which reportedly will reduce postforming costs and inventory requirements, yet give superior performance. The product will be marketed by United States Plywood Corp., Micarta distributor.

The new material is 50 mils thick will be available in all patterns and colors. Extensive tests by fabricators have proven its excellent postformability on all types of postforming equipment, and it meets all NEMA standards for postforming grade. It will, however, sell at the lower prices of non-postforming standard 1/16-inch grades. Abrasion resistance superior to all other existing types, plus better core-hiding qualities, are claimed for the material.

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New Literature

Write item numbers on Readers' Service Card (p. 85) to obtain more information.

"Handbook of Blast Cleaning Ideas." Catalog No. 143-D. Wheelabrator Corp. 27 pages. Various blast cleaning, finishing and shot-peening procedures using Wheelabrator's airless abrasive blast method are described in this booklet. More than 50 case history accounts are included, and specific types of Wheelabrator cleaning equipment are described.

Readers' Service Item 61

"Scientific Design Co.—Designers and Builders of Chemical Plants." Scientific Design Co. 26 pages. Depicted herein are many of the chemical plants designed by the firm in eight countries, and involving 31 processes. A three-page fold-out diagram shows the main stages and sequence of functions in building a plant from "scoping" to plant operation.

Readers' Service Item 62

"Vacuum Forming Molds." Metamold Forming Co. 4 pages. This booklet describes the firm's facilities for making plaster (gypsum-plastic), furan and epoxy resin, and spray metal (zinc and aluminum) molds; sculptures; models; and patterns. The three types of molds used in thermoforming are described in some detail. Plaster molds are the cheapest, and are used mainly for proofs and sample runs. Resin molds are used for medium runs, or for runs which do not require a built-in cooling system. The spray metal molds have built-in cooling systems, and are backed with epoxies to assure sufficient strength for long production runs.

Readers' Service Item 63

"Hardman Triplematic Pumps." H. V. Hardman Co. 4 pages. Specifications are given for the line, which mix, meter, and dispense two-part resin systems. A listing of Hardman compounds used in the plastics and rubber industries also is included.

Readers' Service Item 64

"Sure-Flex Flexible Couplings." Bulletin No. 10100A. T.B. Wood's Sons. 7 pages. This illustrated brochure describes the company's line of flexible couplings and incorporates selection tables showing power transmissions at various service factors, as well as operational behaviour for the various sizes and types.

Readers' Service Item 65

"Heat Resistant Molding Powders." CDC-355. General Electric Co.'s Chemical Materials Department. 6 pages. Properties and applications of G-E 12980, 12981, and 12982 heat-resistant phenolic molding powders are listed in this bulletin.

Readers' Service Item 66

"NRC Vacuum Impregnation Equipment." Bulletin 1-2. NRC Equipment Corp. 28 pages. European and American high-vacuum impregnating, drying, degassing, and filling techniques of special interest to manufacturers and users of electrical distribution equipment, electronic components, and thermosetting resins are described. Photos and schematic drawings illustrate the German methods and equipment developed by Leybold-Hochvakuum-Anlagen, G.m.b.H.

Readers' Service Item 67

"Engineering Data—Thermoplastic Materials." Comco Plastics, Inc. 3 pages. Designed in a chart format, this leaflet compares the physical, electrical, and chemical properties of nine widely used thermoplastic materials.

Readers' Service Item 68

"Vinylpyrrolidone." Antara Chemicals 26 pages. This brochure details copolymerization of the material with other monomers for use as coatings, adhesives, glass-laminating resins, synthetic fibers, and textile sizes. Properties are listed.

Readers' Service Item 69

"Kel-F Halofluorocarbon Products." Minnesota Mining & Mfg. Co. 8 pages. Properties, formulations, and applications are described; and the latter are illustrated in this bulletin.

Readers' Service Item 70

"Web Process Engineering." Gen. Cat. No. 10. John Waldron Corp. 128 pages. This illustrated catalog will acquaint converters of paper, plastics, metals, textiles, and rubber with the scope of Waldron's services in this field. Mechanical and auxiliary equipment also are described as well as the firm's experimental laboratory at New Brunswick, N. J.

Readers' Service Item 71

"Durez Polyester Colors." D-200. Durez Plastics Division, Hooker Chemical Corp. 8 pages. Colored photos illustrate many of the applications for these vari-colored materials, which are said to feature color fastness, dimensional stability, and excellent physical and electrical properties.

Readers' Service Item 72

"Banbury Mixers." Bulletin No. 207. Farrel-Birmingham Co., Inc. 36 pages. This bulletin lists information on the applications, design features, sizes, capacities, installation, operation, and repair of its Banbury mixer line. Numerous illustrations are included.

Readers' Service Item 73

"Corrosion-Resistant Glassed-Steel Conical Dry Blender." Bulletin 963. Pfaudler Co., division of Pfaudler-Permutit, Inc. 4 pages. Special feature of this basic dry blender is that it can also impregnate, concentrate, react, or coat. Specifications and dimensions are included.

Readers' Service Item 74

"Corrosion Resistant Plastic Equipment." Haveg Industries, Inc. 7 pages. Physical properties, chemical resistance, and typical equipment applications of phenolic, furane, polyvinyl chloride, polyester-glass, and tetrafluoroethylene plastics are given a concise coverage with tables, pictures, diagrams, and descriptions.

Readers' Service Item 75

"Richardson Data Sheet 5802." Richardson Scale Co. 1 page. A fully automatic blending scale for proportioning various grades of free-running materials is described and illustrated by this sheet.

Readers' Service Item 76

"Technical Bulletin I-12R — Adipic Acid." Allied Chemical Corp., National Aniline Div. 35 pages. This revised edition comprises 36 pages of basic data for the researcher—including physical properties, six pages of chemical properties and reactions, 19 pages of suggested uses, as well as a list of 271 literature references.

Readers' Service Item 77

"Zytel Nylon Resins." Issue No. 3, 1958. E. I. du Pont de Nemours & Co., Inc. 3 pages. An excerpt from Polychemicals Department's digest of design applications, this leaflet demonstrates how a new design for check valves uses a body of molded Zytel and reduces the number of component parts from 10 to six.

Readers' Service Item 78

Periodic Chart of the Atoms. Copyright W. M. Welch Mfg. Company, Chicago

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Book Reviews

"Plastics in Building Illumination." Building Research Institute, 2101 Constitution Ave., Washington 25, D.C. Paper, 8½ by 11 inches, 99 pages. Price, $3.00.

Twelve papers which were presented at BRI's fifth plastics study group meeting held in Houston, Texas, last March, are reproduced in this volume. The papers fell into three subject categories defined as: Objectives of Building Illumination; Plastics Applications in Building Illumination; and Future Applications of Plastics in Building Illumination. Both building and plastics industry round-up discussions are reproduced in addition to summaries of luncheon talks.

"Synthesis and Characterization of New Vinyl Polymers." L. E. Coleman, Jr., and W. S. Durrell, Wright Air Development Center, U. S. Air Force. Order PB 131669 from OTS, U.S. Department of Commerce, Washington 25, D. C. Paper, 24 pages. Price, 75¢.

Determinations were made of the polymerization characteristics of four classes of experimental monomers, and a preliminary evaluation was made of resulting polymers with respect to thermal stability and resistance to solvents. Monomers investigated were fluorine-containing acrylates, styrenes, unsaturated ketones, and ferrocene-containing unsaturated ketones.

Perfluoroakyl propenyl ketones copolymerize with such monomers as vinyl acetate, styrene, and butadiene to give products ranging from powders to elastomers. The others fell in that range.

"Dictionnaire des Matieres Plastiques et de leurs Applications." Jean Delorme, Publishers Editions Amphora, 119 Avenue Parmentier, Paris Xi, France. Cloth, 12½ by 9¾ inches, 354 plus 84 pages.

The editor of "l'Officiel des Plastiques" has had the good idea of preparing a glossary of plastics and their application for the French plastics industry. Of the three parts into which the material has been divided, the most important is the first, the "dictionary" proper, which covers 248 pages and includes, in alphabetical order, French and foreign products (preparation and properties); plastics and synthetic resins (general methods of producing and processing them, major properties and applications); solvents and plasticizers; pigments; machinery and processes, frequently accompanied by illustrations; common trade terms are explained and the essentials of the chief laboratory tests for plastics are given; and various scientific and technological concepts are defined.

Part two reviews applications, again in alphabetical order, and also gives French equivalents for some 40 German and about twice that number of English technical terms commonly used in the plastics industry. A selection of French books and monographs on different aspects of the industry, and the leading French plastics trade papers, concludes this part. The third and final section presents a classified list of advertisers and their products. The work obviously provides a good deal of information that should be very useful both to the interested layman and the technologist.

"Measurements of the Thermal Properties of Various Aircraft Structural Materials." P. C. Covington and S. Oglesby, Jr., Southern Research Institute for Wright Air Development Center, U. S. Air Force. Order PB 131432 from OTS, U. S. Department of Commerce, Washington 25, ton 25, D.C. Paper, 22 pages. Price, 75¢.

Thermal properties were measured for a group of metal and plastic structural materials including honeycomb cores, a foamed-core sandwich panel, a laminated panel, and sandwich panels with various honeycomb cores and facing materials. Measurements were taken of specific heat and thermal conductivity from minus 50 to 600° F., and thermal expanison from minus 100 to 600° F. Physical properties determined for the materials included Barcol hardness, resin content, and flexural strength.

"The Development of a Non-Adhering Chemically Foamed-in-Place Polyurethane Cushioning Material for Packaging Purposes." S. Childers and S. Allinikov, Wright Air Development Center, U. S. Air Force. Order PB 131665 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 22 pages. Price, 75c.

Although the development of machines for foaming urethane materials in place has brought reductions in packaging costs, a problem has been the adhesion of the foam to the surfaces of many materials. A chemical process was developed for the production of non-adhering polyurethane foams. In addition, several organic acids were evaluated as release agents and it was found that fatty acids such as stearic impart excellent release properties for bare metal and glass surfaces.

Release agents also improves stress-strain properties and varied densities, thus altering the cushioning properties. The report discusses the effect of the release agent on the foaming process and the finished product. Graphs and a comparison analysis of the dynamic and static cushion properties are presented for a polyurethane cushion with and without a release agent.

"Evaluation of High-Molecular-Weight Polyethylene Ropes." L. J. Sheehan, Boston Naval Shipyard. Order PB 131687 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 10 pages. Price, 50c.

Outstanding resistance to weather and heat, plus no permanent plastic flow under sustained normal load were reported for ropes of stabilized, pigmented, high-molecular-weight polyethylene. Clear, unstabilized polyethylene ropes used in comparison tests suffered strength loss of 90% after 12 months exposure to sunlight. The high-density ropes were recommended for Naval service as messengers, life lines, and floating nets.

"An Engineering Study of Vacuum Metallizing." University of Denver for U. S. Army Ordnance Corps. Order PB 131542 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 32 pages. Price, $1.00.

Object of the study was to determine the feasibility of using the economical vacuum metallizing process in lieu of electroplating for coatings on ordnance material, particularly electrical components. This process has been used extensively for the rapid production of extremely thin

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metallic films on glass, metals, and plastics.

It was found that thick deposits (one mil) of cadmium, zinc, lead, silver, and copper can be applied readily to metallic specimens by vacuum evaporation through the use of a tantalum-boat type of heating source. Aluminum, chromium, titanium, and nickel can be deposited in thin coatings of 0.1 mil by the use of tungsten wire filaments. Multiple strands of tungsten wire were used to produce thicker coatings, but difficulties arose concerning hte high temperatures required and the tendency of the charge metals to alloy with filament material.

"Plastics and Adhesives: A Guide to Their Physical Properties and Uses." L. R. Dallet and W. E. Donaldson, U.S. Naval Ordnance Test Station. Order PB 131686 from OTS U.S. Department of Commerce, Washington 25, D. C. Paper, 113 pages. Price, $2.50.

Described as a guide to the rapid evaluation and selection of the best plastic and adhesive for specific applications, the report is a condensed compilation of facts pertaining to the physical properties and uses of both materials for use by rocket ordnance. A section is devoted to the design of molded plastic parts.

Stresses which develop in a reinforced plastic tube under conditions applicable to the design of rocket-motor tubes are calculated. Adhesives are discussed from both theoretical and practical points of view. The report concludes with a general bibliography.

"The Response of Linear Polymers to Hydrostatic Pressure." S. Matsuoka and B. Maxwell. Princeton University for U. S. Army Signal Corps. Order PB 131684 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 49 pages. Price, $1.50.

This report emphasizes the fact that careful consideration must be given to the effects of bulk compressibility of plastic melts on commercial fabrication conditions as well as on properties of the finished products. Testing involved subjecting two types of linear polymers to hydrostatic compression: one was polystyrene, as a representative of amorphous polymers; the other was polyethylene, a polycrystalline polymer.

Among the conclusions, it was found that the bulk compressibility of linear high polymers is a function of temperature, pressure, and time. The melts are highly compressible, and the addition of pressure will cause structural change in some. In hydrostatic compression, pressure must be increased along with temperature. Polyethylene became more dense, rigid, and crystalline on cooling.

"The Chemistry of Cross-Linking of Polyurethanes." M. Orchin, H. Schulze, C. Reilly, and M. R. Huey, University of Cincinnati, for Wright Air Development Center, U. S. Air Force. Order PB 131994 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 17 pages. Price, 75c.

Since urethane linkage is stable, failure of a polymer under stress is probably caused by the breaking of other than urethane linkages. The relative reactivities of urea, urethane, and substituted linkages were studied by measuring reaction rates with suitable monomers. A urethane composed of a low-boiling alcohol could be cleaved by heating in vacuum, with preferential removal of the isocyanate from the reaction vessel. A test was developed for comparing standard polymers with modified products. This test detects improvements due not only to the number and types of cross linkages, but to the variation of unit groups or chain links. A standard polymer was developed for use in this tests.

"Design Data for O-Rings and Similar Elastic Seals." G. E. Trepus, Boeing Airplane Co. for Wright Air Development Center, U. S. Air Force. Order PB 131510 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 114 pages. Price, $3.00.

A study was made of the relationships between the physical properties of rubber-like seal materials and their sealing efficiency in order to improve design possibilities. A literature survey on O-rings and seal design was conducted, and all of the commercially available polymers were compounded with various physical properties. O-ring grooves of different configurations, rotating shafts, and reciprocating-shaft functional test jigs were designed and prepared.

Seal tests under different environmental and mechanical conditions were run on these jigs. No relationship was found between physical properties and seal efficiency. A general relationship, however, was established between seal life and compression modulus and relaxation.

"Expansion Characteristics of Marlex 20 and Marlex 50." H. Marcus and F. V. Zaleski, Wright Air Development Center, U. S. Air Force. Order PB 131402 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 26 pages. Price, 75¢.

A technique was developed for the volume dilatometry of plastic materials and applied to the determination of thermal behavior of the two materials. It consisted of sealing a test sample in a glass tube with mercury as the confining fluid. The change in volume of mercury was noted at different temperatures, and the volume expansion of the test sample was calculated from the known expansitivities of glass and mercury.

The tests showed Marlex 50 superior to Marlex 20 in high-temperature properties. Each series of six test samples contained one non-irradiated sample and five which had received increasing doses of gamma radiation.

"Ideas, Inventions, and Patents." Robert A. Buckles. John Wiley & Sons. 440 Fourth Ave., New York 16, N. Y. Cloth, 6 by 9¼ inches, 270 pages. Price, $5.95.

In this work, Mr. Buckles examines the principles behind patents in all fields of technology including mechanical, electrical, chemical, and nuclear. Specific examples, in each area, are given, and the reader is taken step-by-step through the complete case history of a simple invention. Readers who have had no previous experience with the Patent Office or with patent attorneys will find this book an invaluable reference. A glossary of patent terms is included as well as illustrations from patents and patent drawings.

"The Properties and Testing of Plastics Materials." A. E. Lever and J. Rhys. Chemical Publishing Co., Inc., 212 Fifth Ave., New York, N. Y. Cloth, 6 x 9¼ inches, 197 pages. Price, $4.75.

A reference work for those engaged in the testing of plastics, this book contains comparative technical information on a wide variety of materials used in plastics manufacture. Much of the information is in tabular form, and the reader can study particular problems without the necessity of extensive literature searches. Main topics covered are general principles, physical, thermal, optical and electrical properties, sundry chemical and physical properties, identification and analysis, industrial materials, special tests and properties, testing of finished moldings, efficiency of plasticizers, and standards of organizations. More than 1,600 references, an index, and an extensive glossary are included.

Abstracts of Important Articles

Materials

"Reinforcing Epoxy with Metal Fiber," A. P. Mazzucchelli, *SPE J.*, 14, 10, 37 (Oct. 1958).

This is the final part of a paper presented at the annual meeting of the American Society of Tool Engineers, and dealing with case histories of commercial compositions for tools and dies.

"Perfluorocarbon Resin," R. S. Mallouk and W. B. Thompson, *SPE J.*, 14, 10, 42 (Oct. 1958).

An SPE 1958 Conference paper describing the properties of Teflon 100X.

"Tensile and Compressive Properties of Fiberglass Reinforced Laminates," R. E. Chambers and F. J. McGarry, *ASTM Bull.*, No. 233, Pg. 40 (Oct. 1958).

A new technique uses bonded foil resistance strain gages to measure interior distortion through the thicknesses of fiberglass-plastic laminates.

"Rapid Determination of Moisture Capacity, Diffusion Coefficients, and Activation Energy in Plastics Laminates," J. W. Rowen and R. K. Laudenslager, *Modern Plastics*, 36, 3, 222 (Nov. 1958).

Three different procedures for determining sorption characteristics are discussed.

"Chemical and Physical Changes in Gamma-Irradiated Plastics," Robert Harrington and Richard Giberson, *Modern Plastics*, 36, 3, 199 (Nov. 1958).

Results are given for irradiation of certain plastics materials, including polycarbonates, polyethylenes, polyfluorocarbons, polyesters, polystyrenes, and vinyls.

"Diaphragm Behavior of Plastic Disks," A. G. H. Dietz and F. J. McGarry, *Modern Plastics*, 36, 1, 135 (Sept. 1958).

Results are given of a testing program for methyl methacrylate disks under different loading conditions.

"Low Temperature Properties of Plastics Foams," R. M. McClintock, *SPE J.*, 14, 11, 36 (Nov. 1958).

Tensile strengths of foam plastics in cryogenic applications are shown to depend on dimensions and orientation of built-in notches formed by the cell walls.

"A High Shear Rate Capillary Rheometer for Polymer Melts," E. H. Merz and R. E. Colwell, *ASTM Bull.*, No. 232, pg. 63 (Sept. 1958).

A rheometer for polymer melts is described that will measure the melt properties at usual processing temperatures and rates of shear.

"Bonding Properties of a Solventless Cyanoacrylate Adhesive," M. J. Bodnar and W. H. Schrader, *Modern Plastics*, 36, 1, 142 (Sept. 1958).

Properties of Eastman 901 adhesive are described, and results are given of a testing program and results obtained for this solventless, room temperature-curing adhesive.

"Effect of Small Quantities of Plasticizers in PVC Compounds," P. Ghersa, *Modern Plastics*, 36, 2, 135 (Oct. 1958).

Data are given for test results on mechanical properties of PVC obtained with various plasticizers.

"Polymerization with Radiation. Part II—Technological Considerations," Robert McFedries, *SPE J.*, 14, 10, 33 (Oct. 1958).

This second and final part of the SPE 1958 Conference paper covers the subjects of fatal dose, dose rate, and dose variation.

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines is printed here quarterly.

The next complete listing will appear in February. The last listing appeared in the October issue.

"Service Test Data on High-Density Polyethylene," W. E. Gloor, *Modern Plastics*, 36, 2, 144 (Oct. 1958).

This SPE 1958 Conference paper deals with the application of Larson-Miller correlation to the service data obtained with stress-cracking test data and pipe design.

"Testing the Corrosive Effect of Plastics on Metals," E. Peukert, *Kunststoffe*, 48, 5, 213 (May 1958).

Experience of recent years has revealed how important it is that plastics used as insulations in telecommunication and electrical measuring instruments, in a relatively humid atmosphere and under tropical conditions, should have no corrosive effect on metals. The author examines existing methods of determining this corrosive effect and describes his own improved apparatus and method. He then discusses the problems involved in evaluating results, and finally touches on the probable causes of corrosion. (In German.)

"Factors Influencing Transparency of Glass Fiber Reinforced Polyesters," L. Turunen and B. Berndtsson, *Kunststoffe*, 48, 5, 200 (May 1958).

The transparency of glass-fiber reinforced polyester sheet is influenced by a number of factors besides the resin and the glass fiber. Results of investigations are reported on the effects of catalytic and accelerator systems, temperature and setting time, post-curing, impregnation and addition of monomeric styrene, glass content, and thickness of sheet. Light transmission and light scattering also were measured. (In German.)

"Physical Properties of Monomeric Acrolein and of some Polyacroleins," R. C. Schulz, *Kunststoffe*, 48, 6, 257 (June 1958).

Some of the physical characteristics of certain high molecular polyacroleins are described and compared with those of other vinyl polymers. Molecular refraction and infra-red spectra provided indications concerning the most essential structural elements. These agree with the formulas derived from previous chemical reactions. (In German.)

"Relation between Properties and Molding Methods of Thermoplastics," M. Chatain, *Ind. Plastiques Mod.*, 10, 5, 45; 10, 6, 37 (May & June 1958).

The first of the four parts of this study deals with residual orientation strains and the parts played here by the flow characteristics of the material and the type of mold and gating selected. The tests reported concern only wide gating; tests using pin-point gating are in progress. The second section of the article discusses the detection of internal stresses through heat deformation and anisotropy. A description

is given in the third part of tests on controlled injection molding of various commercial polystyrenes aimed at determining the possible effects of processing conditions on the mechanical properties of the finished product. The concluding paragraphs give processing hints based on results of the tests for use by molders and testing laboratories. (In French.)

"Electrical Testing Methods for Plastics," H. Suhr, *Plastverarbeiter*, 10, 10, 374 (Oct. 1957).

Electrical testing methods for plastics come under four main groups: measurements of electrical resistance; dielectric measurements (loss factors and dielectric constant); dielectric strength; and special tests (arc and tracking resistance). The individual tests are described, reference being made to DIN (German) and A.S.T.M. spefications and I.E.C. proposals. (In German.)

"Improving Craze and Impact Resistance of Transparent Plastics by Multiaxial Stretching," G. M. Kline, *Ind. Plastiques Mod.*, 10, 6, 30 (June 1958).

This is a paper presented at the Paris Plastics Meeting in July 1957, and describes research conducted on polymethyl methacrylate and other acrylics by the National Bureau of Standards under the auspices and aid of the National Advisory Committee for Aeronautics. (In French.)

"Flammability of Plastic Sheet," K. Thinius, *Plaste u. Kautschuk*, 4, 10, 367 (Oct. 1957).

Sheets made from cellulose derivatives and both polymerization and polycondensation products were tested by various methods to determine the degrees of their flammability. Tables compare the results of the Willbourne, the "chimney," and the American (Malm, Baumer and Hiatt) tests. Non-flammable plasticized PVC sheet was produced experimentally with tricresylphosphate plus chlorinated plasticizers in such proportion that the former exceeded the latter plasticizer. Antimony peroxide as pigment gave a similar effect. In these tests, no properties other than flammability were considered. (In German.)

Equipment

"Pneumatic Feed Systems for Granulated Material," W. Paul, *Kunststoffe*, 48, 6, 283 (June 1958).

The operation and action of three feed devices for granulated material now on the world market are described. These are: (1) a relatively elaborate German machine on wheels for use with extruders that conveys 100-6,000 kilograms per hour up to a height of 10 meters; (2) the American automatic hopper leader by Whitlock; and (3) a Viennese model that includes a container for 100 kilograms of granules and a filter for supplying dry air, and conveys any kind of free-flowing granules at the rate of 2.5 kilograms per minute at 3.5 atmosphere of pressure. (In German.)

"Economics of Unscrewing Molds," Islyn Thomas and E. J. Csaszar, *Modern Plastics*, 36, 3, 181 (Nov. 1958).

It is shown that costs can be greatly reduced by standardizing mold-base designs to accept interchangeable parts.

"Plastics Processing Machines and the Fields for their Use," W. Radehaus, *Plaste u. Kautschuk*, 4, 9, 327; 4, 10, 381; 4, 11, 423; 5, 1, 15; 5, 2, 64 (Sept.-Nov. 1957; Jan. & Feb. 1958).

A series article describing and discussing various types of machinery designed for the plastics industry, and where and how they should be employed. (In German.)

"Some Aids to the Design of Dies for Plastics Extrusion," D. F. Weeks, *Brit. Plastics*, 31, 4, 156; 31, 5, 201 (April & May 1958).

Available information on the prediction of pressure and flow in dies is presented for the convenience of designers. Part I considers pressure prediction, and explains the bases and applications of the expressions for pressure drop. Part II deals with the prediction of flow distribution in a center or end-fed wide sheet die, or in side-fed tube or film dies. Expressions were derived that give the required internal dimensions for a specified thickness tolerance across the product. Also described is visual simulation of flow with transparent models to discover and eliminate dead spaces. However, stressing, distortion, and heating of dies are not specifically covered. In appendices, examples are given of pressure prediction and the designing of dies.

"Injection Molding Machine Drives," F. R. Gloekner, *Modern Plastics*, 36, 3, 194 (Nov. 1958).

An evaluation of drive requirements can save in power and motor costs.

Processing

"The Production of Porous Leather Cloth," H. G. Schwabe, *Kunststoffe*, 48, 9, 285 (June 1958).

The known methods for producing PVC leather cloth or sheet that "breathes" (i.e., permeable to air yet excludes moisture) are described. These include mechanical and electrical means, the use of additives, and partial coating of the support. Details are also given of the "Dornair" process, a new method with which interesting effects are obtainable in covering sheet metal, wood, cardboard and fiber glass supports. (In German.)

"Low Pressure Molding of Fiber-reinforced Polyester Resins," B. Bossu and J. Coves, *Rev. Plasticos*, 8, 48, 335 (Nov.-Dec. 1957).

In this discussion of problems connected with low-pressure molding of polyester resins reinforced with various kinds of fiber, the choice of materials, fillers, compounding ingredients, molds, as well as the preparation of pre-forms and the molding process itself, are considered. (In Spanish.)

"Adhesive Bonding of Metals. Part I. Conditions for Perfect Adhesive Bonds," H. Peukert, *Kunststoffe*, 48, 5, 236 (May 1958).

The development of special synthetic resin adhesives has made possible strong and technically efficient adhesive bonding of metal assemblies. So far, this method is used mainly for light constructions. This part of the article deals with the physicochemical principles of the technique, the factors that insure perfect bonding, (pretreatment of metal surfaces), the properties to be looked for in selecting a synthetic resin from the various types available, and the means for improving bond strength. (In German.)

"Sequential Impact Molding," G. D. Gilmore and Judson Decker, *Modern Plastics*, 36, 3, 187 (Nov. 1958).

Fast-acting valves in multiple nozzles permit the precompressing of the injection cylinder contents, then "exploding" the melt into each cavity.

"Continuous Forming of Fibrous Mat," P. E. Fuerst, *Modern Plastics*, 36, 2, 115 (Oct. 1958).

A new process is described that permits continuous forming of fibrous mats, both with and without fillers, resins, or other additives.

"High-Speed Masking Process," R. W. Clogg, *Modern Plastics*, 36, 2, 123 (Oct. 1958).

Brief description of a masking process that uses a sprayed coating that after decorating is stripped off.

"Fluidized Polymer Deposition," R. L. Checkel, *Modern Plastics*, 36, 2, 125 (Oct. 1958).

The use of a fluidized air-agitated plastic

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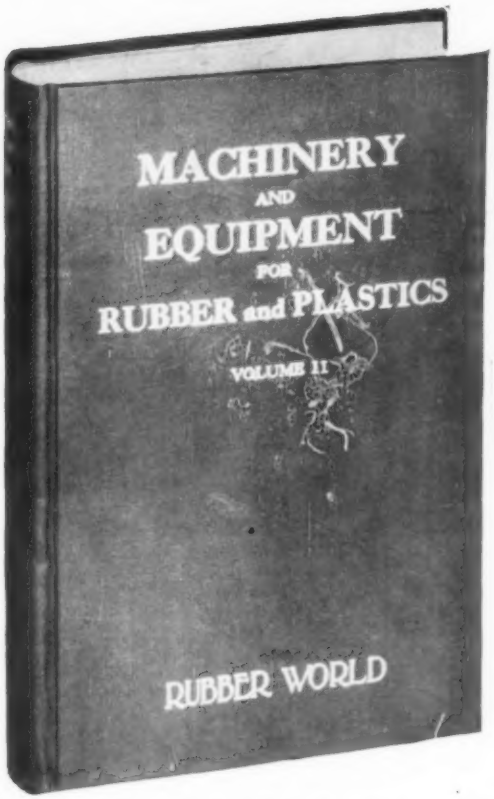

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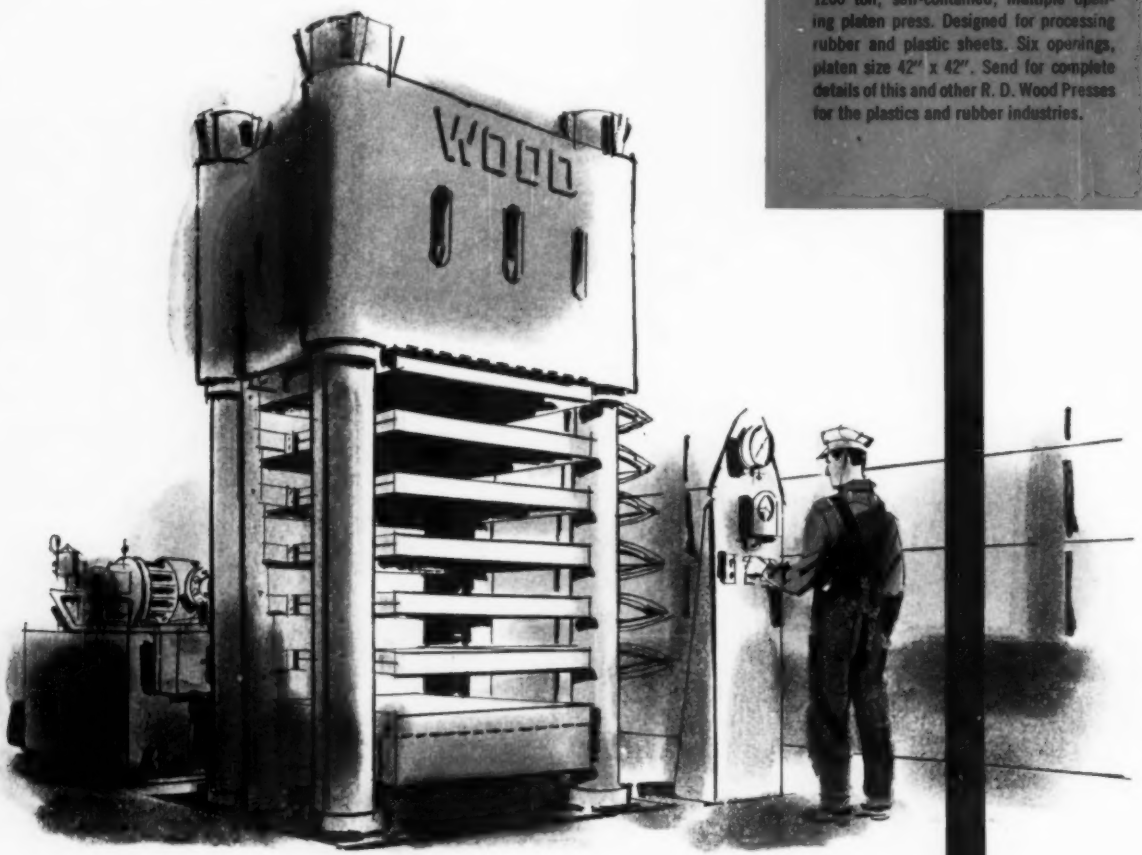

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powder bed as a means for applying protective coatings and as a general plastic fabrication technique is described.

"Injection Molding of Rigid Polyethylenes," P. J. Boeke and J. N. Scott, *Western Plastics*, 5, 9, 22 (Sept. 1958).

Injection molding considerations are discussed by means of several examples that show proper water channeling.

"Valve Gating of Injection Molds," Albert Spaak and George Kelly, *Modern Plastics*, 36, 1, 117 (Sept. 1958).

Valve-gated molds are hot-runner molds where the conventional gates have been replaced with quick-opening valves.

"Pretreatment and Printing of Polyethylene," W. Kuhn, *Kunststoffe*, 48, 6, 242 (June 1958).

An account of the different methods (chiefly American) of treating polyethylene surfaces to make them suitable for printing, followed by a discussion of the four processes for printing this plastic (typography, screen printing, photogravure, and printing with rubber rolls). The last method, being the most generally used, is dealt with in some detail and five German machines designed for it are described; also two machines for screen printing. Special machines are being developed for photogravure of polyethylene, but no illustrations as yet are available. (In German.)

"Technical Guidance for Injection Molding of Polyamides," W. Oleff, *Plastverarbeiter*, 10, 10, 367 (Oct. 1957).

To aid the molder in successful injection-molding of polyamides, a number of pointers are given on such points as conditions under which fully- or semi-automatic operation is possible; ejection of molded parts; advantages of manually-operated machines; care in storing material; molding samples; inspection; correction of defects; temperature; and nozzle types. (In German.)

"Polyethylene-Coated Filter Pipes in Well Construction," T. Engel, *Kunststoffe*, 48, 7, 348 (July 1958).

Mention is made of a process for coating slit-perforated and plain steel filter pipe for wells with a special, pre-treated, very finely-pulverized polyethylene containing a suitable pigment. The polyethylene undergoes no preheating or pre-plasticization before being sprayed onto the heated pipe. The method is said to give a firmly-adhering coat of plastic, extra thick at the sharp edges and ridges of the slit perforations, that was high mechanical strength and offers excellent protection against chemical and electrical corrosion. (In German.)

"Recent Developments in the Transformation of Semi-finished Rigid Polyethylene Products," E. Rottner, *Kunststoffe*, 48, 7, 345 (July 1958).

The article deals with the welding of rigid polyethylene sheet, pipe and metal-reinforced pipe to form such articles as flush tanks, storage bins, sifting baskets, air exhausts and the like. Two new welding tools are described. (In German.)

"Bonding Nylon Polyamides to Different Kinds of Materials," J. Hacquard, *Ind. Plastiques Mod.*, 10, 7, 8, (July-Aug. 1958).

Brief review of problems encountered and adhesives used in bonding nylon to itself, and to leather, metals, cork or cardboard, rubber and glass. (In French.)

"Progress in Extrusion," E. C. Bernhardt, *Modern Plastics*, 36, 4, 115 (Dec. 1958).

A discussion of some of the recent developments in extrusion machines.

"Sheet Formed Plastics Parts," J. C. Merriam, *Matls. Design Eng.*, 48, 6, 121 (Nov. 1958).

A brief review of sheet forming dealing with types of sheets, plastics materials and forming methods, and design limitations.

Applications

"The Use of Resins in the Preparation of Metallographic Samples," M. Leone, *Materie Plastiche*, 23, 11, 894 (Nov. 1957).

The selection of resins for specific purposes, and the method of mounting metal samples are briefly described. (In Italian.)

"Growing Importance of Plastics for Automobile Bodies," M. Parducci, *Materie Plastiche*, 23, 11, 904 (Nov. 1957).

The special properties of glass-reinforced polyester resins quickly suggested their use for making automobile bodies. The progress in this direction in the last eight years, demonstrated in various American and European cars, is reviewed. Details are given of some of the problems encountered in the construction of the plastic body for an experimental turbine car made by Renault. The case of very small cars is also covered. (In Italian.)

"Plastics in Horticulture in the Sahara," M. Chouard, *Ind. Plastiques Mod.*, 10, 7, 3 (July-Aug. 1958).

If traditional irrigation systems were replaced by proper methods of moisture conservation — employing plastics — the present cultivated area in the Sahara could be doubled or trebled, the author believes, and suggests various means that he thinks should be carefully investigated. He describes the use of plastic subsurface piping to water plant roots; subsurface plastic sheet to retain moisture; sheet above ground to promote condensation of moisture and to prevent evaporation, as well as to maintain desirable temperature conditions; and plastic frames to promote condensation of brackish water to remove salt. (In French.)

"Plastic Sheet in Building Technique and on Building Grounds," K. Evelt, *Kunststoff-Rundschau*, 4, 10, 438 (Oct. 1957).

Reference is made particularly to the uses of polyethylene sheet to speed-up building and aid efficiency (for example, to protect all kinds of fresh concrete surfaces), as moisture and vapor barriers under floors; as weather protection for uncompleted buildings, materials and equipment; and in roof construction. (In German.)

"A Unique One-Piece Molding," K. A. Schneider, *Plastics Industry*, 16, 12, 34 (Dec. 1958).

Method of molding, design requirements, tooling, materials of fabrication, and testing of a prototype helicopter contravane.

"Plastics Pressure Vessels," A. J. Wiltshire, *Materials Design Eng.*, 48, 6, 101 (Nov. 1958).

An up-to-date report on types of vessels, materials used, and proper design.

"Reinforced Translucent Panels," G. R. Huisman, *Plastics Industry*, 16, 11, 36 (Nov. 1958).

How one processor uses quality control for adequate inspection of production.

"Polyolefins Look for More Container Applications," W. O. Bracken, *SPE J.*, 14, 11, 21 (Nov. 1958).

Review of methods, materials, and the future market forecast for containers made of plastics.

"Designing Plastics Lenses for Cars," A. Meyer, Jr., *SPE J.*, 14, 10, 31 (Oct. 1958).

Constant development of new plastics materials and techniques permits the designing of automobile lighting equipment with better safety features.

"Use of Plastics as Bonding Agents and Adhesives," I. Puig, *Rev. Plasticos*, 8, 48, 329 (Nov.-Dec. 1957).

Review of some recent uses of plastic adhesives and bonding materials, as reported in Europe and the United States. (In Spanish.)

"Designing Stiffness into Plastics Structures," Sidney Levy, *Modern Plastics*, 36, 1, 123 (Sept. 1958).

An engineering approach to proper design of plastic structures.

"Vinyl-Metal Laminates," R. J. Fabian, *Materials Design Eng.*, 48, 4, 98 (Oct. 1958).

An up-to-date survey of the laminates and their applications.

"Plastic Packaging for the Chemical Industry," E. Ramspeck, *Kunststoffe*, 48, 2, 65 (Feb. 1958).

A report on the properties and possibilities of various plastics offered by a leading German raw materials concern for use as a packaging material and packaging aids by the chemical industry. Included are caprolactam-based polyamide film and bottles; transparent cellulose acetate and acetobutyrate bottles and boxes; oil-and fat-resistant containers of Novodur (acrylonitrile/butadiene/styrene copolymer); Moltroprene for protecting glass containers; large transportation tanks of unsaturated polyester; di-isocyanate-based coatings, also for tropical uses; a melamine product for increasing the wet-strengths of paper bags; and a silicone rubber dispersion for preventing adherence of contents. Small polycarbonate boxes, ampules, tubes, etc. also will become available soon. (In German.)

"Vacuum Metallizing in the Automotive Industry," William Pahl, *SPE J.*, 14, 10, 29 (Oct. 1958).

Indications are that first-surface vacuum metallized finishes could be used for many interior trim parts now chrome-plated or painted.

"Plastics Take to the Road," A. W. Shearer, *SPE J.*, 14, 10, 23 (Oct. 1958).

How plastics are used in approximately 18 pounds of volume in modern automobiles.

"Progress in Vacuum-formed Packaging," R. Moreau, *Plastiques Informations*, 8, 167, 25 (Oct. 16, 1957).

The advantages in weight and the economies possible in the production of packaging by vacuum-forming of thermoplastic sheet are explained by comparison with injection-molded packaging. At the same time, the limitations of the former process are brought out. Closure problems also are briefly considered. (In French.)

"What's in Store. Plastic Products for the Kitchen," C. Craig, *Brit. Plastics*, 31, 3, 88 (March 1958).

The views of a British housewife who knows her plastics are presented on articles for the kitchen now available in Britain. She comments on their utility, price, design, colors, and branding, and gives suggestions as to steps that manufacturers should take to increase the housewife's knowledge of plastic goods so that she may buy wisely and be encouraged to use such goods.

General

"College Courses in High Polymers," J. H. Day, *SPE J.*, 14, 12, 25 (Dec. 1958).

Copy of a report presented at the ACS symposium in Chicago on Sept. 7-12, 1958.

"The Future of Glass-reinforced Plastics," J. H. Collins, *Plastics (London)*, 23, 248, 161 (May 1958).

The author reviews failures and successes in the glass-reinforced plastics branch, and considers recent trends. The replacement of the wet lay-up method of matched-metal molding points to the use of cheaper condensation-type resins for many purposes. He foresees more conventional processing methods in the future leading to greatly increased consumption of new reinforcing fibers and new resins. The greatest development is likely to be in matched-metal moldings using dough-molded compounds and pre-impregnated long-fiber reinforcements.

"Brussels Built with Plastics—Constructional and Architectural Elements at the 1958 World's Fair," A. Schwabe, *Kunstoffe*, 48, 7, 327. (July 1958).

Description of the conspicuous plastics elements entering into the construction of 17 different halls and structures seen at the 1958 Brussels Fair. (In German.)

Plastics at Mid-1958—an Outline of Developments in Techniques and Application," K. Mienes, *Kunststoffe*, 48, 7, 289 (July 1958).

Following up a similar review at the end of 1956, the author now highlights the chief advances made to the middle of 1958 in each of the main plastics. He notes the bias against thermoset resins, and stresses the need for increased technological and scientific education in Germany if she is to maintain her position in the international plastics industry. (In German.)

"Plastics and Plastics Machinery at the Hanover Fair, 1958," J. Hausen, *Kunststoffe*, 48, 7, 306 (July 1958).

Comprehensive review of the plastics and plastics machinery shown at the Hanover Fair, 1958. Included are raw materials, semi-finished products, foamed materials, and adjuvants, as well as applications in the building, automobile, electric, packaging and other industries, in addition to all kinds of machinery for processing plastics. (In German.)

"Appropriate Designing of Plastics and Economical Mold Construction," H. Bischoff, *Plaste u. Kautschuk*, 4, 10, 374 (Oct. 1957).

The design of plastics molded parts frequently contributes to the high costs of molds. The expert often can advise the customer on simple changes that will benefit both quality and economy, as is explained by an example. (In German.)

"Report for 1957 on the Activities of the Plastics Section (F.N.K.) of the German Bureau of Standards (D.N.A.)," A. Hoechtlen and G. Ehlers, *Kunststoffe*, 48, 6, 249 (June 1958).

In continuation of the reports on activities in 1956 and preceding years, the present report gives details of further progress in standardization in the fields of plastics. (In German.)

Patent Digest

Materials

Polypropenylbenzene. No. 2,839,517. Lester S. Cohen and Joseph R. Zietz, Jr., Baton Rouge, La. (to Ethyl Corp., New York, N. Y.).

The material is a hard, white polybetamethyl styrene having an average molecular weight of about 3,000 and a melting point above 250° C. It is formed by the polymerization of betamethyl styrene at a temperature below —100° C., in the presence of a Friedel-Crafts catalyst.

Manufacture of Polyethylene of Controlled Molecular Weight. No. 2, 839,518. Donald Lee Brebner, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Ethylene is polymerized to a linear homopolymer having a density of 0.95—0.98 in the presence of an inert liquid hydrocarbon at a temperature of 20—100° C., using an initiator system comprising a titanium halide and a lithium aluminum alkyl.

Process for Resinifying Polyepoxides and Resulting Products. No. 2,839,495. James E. Carey, Maplewood, N. J. (to Shell Development Co., New York, N. Y.).

This process for resinifying and curing a polyepoxide having a 1,2-epoxy equivalency of at least 1:1 comprises mixing and reacting the polyepoxide with a polycarboxylic acid anhydride and an activator.

Epoxide Resins and 1,4,5,6,7,7 Hexachloro 2-(2,3-epoxypropoxymethyl) bicyclo (2.2.1) hept-5-ene. No. 2,839,496. Wilbur L. Bressler and John C. Smith, Lake Jackson, Tex. (to Dow Chemical Co., Midland, Mich.).

From 25 to 75 percent of an epoxide resin is reacted with 25-75 weight percent of the other material. This reaction represents the incorporation of p,p'-isopropylidenediphenol and epichlorohydrin with caustic.

Polymeric Composition of an Acrylic Acid Ester and Cellulose Acetate and Method of Preparation. No. 2,839,479. John R. Caldwell and Russell Gilkey, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

From 25-70 weight percent of an acrylic acid ester and a saturated, monohydric, aliphatic alcohol is polymerized with 20-75 weight percent of a water-soluble cellulose acetate having an acetyl content of 13-19% dissolved in water. This gives a solution of 5-30% concentration. The mixture is agitated at 40-120° C., and hardened by contact with formaldehyde, trimethylol nitromethane, dimethylol urea, or trimethylol melamine.

Fluorinated Acrylate Esters and Polymers Thereof. No. 2,839,513. Arthur H. Ahlbrecht, Ramsey County, William S. Friedlander, St. Croix County, and Wayne A. Severson, Ramsey County, Minn. (to Minnesota Mining & Mfg. Co., St. Paul, Minn.).

This compound is a 1,1,6-trihydro-4-opaxerfluorohexyl acrylate.

Copolymer of Allyl Glycidyl Monoether and Styrene. No. 2,839,514. Edward C. Shokal, Walnut Creek, Paul A. Devlin, San Francisco, and De Loss E. Winkler, Orinda, Calif. (to Shell Development Co., San Francisco, Calif.).

A copolymer of allyl glycidyl monoether and styrene, it contains a three-membered epoxy ring having an epoxy value up to 90% of the theoretical value of the ether.

Compositions of Matter Comprising an Ethoxyline Resin and an Alkylene Polyamine Containing at Least Two Tertiary Amino Groups. No. 2,839,480. Gustav Heinrich Ott, Arlesheim, Adrian Marxer and Heinz Zumstein, Basel, and Kurt Brugger, Binningen, Switzerland. (to Ciba, Ltd., Basel, Switzerland).

The material consists of a resinous polyglycidyl ether of a polyhydric phenol hardened with a polyalkylene polyamine in which at least the two end nitrogen atoms are those of alkyl tertiary amino groups. The hardener should also be free of other substituents capable of reacting with epoxide groups.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Prices, 25c each.
—The Editor

Combinations of Ketone Formaldehyde Reaction Products and Glycidyl Ether of Polyhydric Phenols or Polyhydric Alcohols. No. 2,839,481. Mortimer T. Harvey, South Orange, and Peter L. Rosamilia, Newark, N. J. (to Harvel Research Corp., Irvington, N. J.).

The material is the reaction product of a ketone formaldehyde at a temperature below 300° F., and a glycidyl ether of a polyhydric alcohol or phenol. This latter material should be liquid at a temperature below 350° F. The ratio by weight of former to latter material should be 100: 5-2,000.

Equipment

Device for Shaping Plastic Materials. No. 2,838,790. Eugene H. Hartman, Boonton, N. J. (to United States Rubber Co., New York, N. Y.).

The extruder comprises an elongated extrusion screw having a thread extending from the feed end to a delivery end; a closely-fitting, enclosing cylinder surrounding the screw at the delivery end; a hopper structure partially enclosing the screw at the feed end; a roll disposed in the hopper alongside the exposed portion of the screw; and a means for rotating the roll and screw toward each other. Plastic stock placed on the roll is masticated between it and the screw and charged through the enclosing cylinder at a continuously uniform rate.

Processing

Injection Molding of Perfluorochlorocarbon Plastics. No. 2,834,992. Julius A. Jupa, Elizabeth, N. J. (to Minnesota Mining & Mfg. Co., St. Paul, Minn.).

A polymer of trifluorochloroethylene having a softening point of 200-350° C., and a transition point of about 415° F., is injected from an injection chamber through a central main runner and a plurality of feed runners into a number of die cavities. The improvement is claimed to be the heating of the feed runners to a temperature sufficiently above the transition point, yet below the degradation point. This prevents substantial orientation.

Art of Making Closure Members by Depositing and Curing a Compound in the Closure Shell and Thereafter Molding. No. 2,835,926. Curtis E. Maier, Riverside, Halford E. Brockett, Lombard, and Ralph A. Larson, Chicago, Ill. (to Continental Can Co., Inc., New York, N. Y.).

A semi-liquid paste composition of resin and plasticizer is deposited in the center of a closure shell and heated to the fluxing temperature. This forms a permanent rubbery gel. A heated forming plunger is pressed against the mass to form a

sealing pad of the desired contour. During this action, the closure shell is maintained on a heated support to direct the flow outward and radially.

Method of Welding Thermoplastic Container Parts. No. 2,833,683. Hans Huber-Quandt, Karlsruhe, Germany. (to Rudolf Mohr, Karlsruhe, Germany.).

A thermoplastic cover, having a central portion projecting from a peripheral flange, is fitted in the open end of a container with the flange seated against the sidewalls. A sheet metal frame, acting as a heat bridge, is positioned over the cover in such a manner that it extends over the juncture point of the two members. After sufficient heat is applied to cause fusion, the bridge is removed and the part is allowed to cool.

Methods of Producing Cellular Plastics. No. 2,835,927. George E. Henning, Baltimore, Md. (to Western Electric Co., Inc., New York, N. Y.).

A mixture of plastic and an expanding agent is forced around a continuously-advancing filamentary core and through an orifice having a longitudinal cross section of a conic section. This orifice is so restricted circumferentially at one point that the ratio of the extruded compound's linear speed to the linear speed of the advancing core is 1.67 or greater. The covered core then is subjected to an abrupt pressure drop causing the agent to expand the mixture into a cellular form having a high percentage of occluded gas.

Method of Producing Glass-Surfaced Low-Pressure Laminates. No. 2,837,457. Thomas R. Baxter, Mount Vernon, O. (to Continental Can Co., Inc., New York, N. Y.).

A carrier web is coated with glass flakes, a thermosetting resin, and a wetting agent. The web then is applied to a fibrous mat to form a panel assembly which is cured and stripped from the web.

Process of Making Mold. No. 2,836,867. Xarifa L. Bean, Yellow Springs, O. (to Morris Bean & Co., Yellow Springs, O.)

The process first involves making a flexible pattern mold with a surface corresponding to the desired surface of the casting mold. The pattern is then surfaced with a settable plaster slurry which sets to a rigid pattern at room temperature, but disintegrates at the setting temperature of a thermosetting resin. The set pattern is removed from the pattern mold, and a non-adhesive binder is applied to grains of sand to hold them together at temperatures above the weakening point of the plaster. This binder decomposes, however, at metal-casting temperatures. When the cast metal part has solidified the at least partially decomposed casting mold is easily removed.

Nylon Extrusion. No. 2,835,925. Donald D. Proctor, Seaford, Del. (to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.).

A reportedly improved method, it consists of replacing a gel-susceptible nylon with a nylon not susceptible to gelling during cessation of extrusion operations.

Method of Fusing High Molecular Weight Polymers at Low Temperatures. No. 2,834,993. Charles D. Dipner, Cranford, N. J. (to Minnesota Mining & Mfg. Co., St. Paul, Minn.).

An unsupported film of chlorofluoroethylene is prepared from a suspension of same in an aromatic hydrocarbon liquid, the bulk of which boils above 160° C. This dispersion is applied to a supporting surface and heated in a non-circulating atmosphere. The soft, partially-dried film is then removed from its support before it has adhered firmly.

Method of Preparing Vinyl Resin Granules and Covering Containing Same. No. 2,835,620. Francis John Woodford Bartlett, Pontypool, Mon. England.

A vinyl resin obtained by dispersion polymerization is plasticized, and its viscosity is raised by heating to 90-140° C. More, unheated material is mixed to give a thick paste, and fillers are added until it reaches a doughy consistency. It can then be disintegrated into lumps or granules without recoagulation until subjected to pressure.

Process for Forming Shaped Bodies From Polyethylene. No. 2,829,118. Wilhelm Wehr, Hanau, Main, Germany. (to Deutsche Gold- und Silber-Scheideanstalt, vormals Roessler, Frankfurt am Main, Germany.).

Polyethylene is swollen in a solvent at a temperature below that necessary to make it enter into solution. Following removal of excess solvent, the polyethylene is fused and shaped at an elevated temperature to form a shaped body.

Applications

Modified Polyvinyl Acetal Insulated Conductors. No. 2,836,518. John A. Loritsch and Edward W. Daszewski, Schenectady, N. Y. (to General Electric Co., Schenectady, N. Y.).

A hard, flexible, abrasion- and Freon-resistant coating for copper conductors is made using 50-95% by weight of a polyvinyl formal resin, 5-50% by weight of a heat-hardenable resin, and 0.3-1.2% by weight of a urea or pyrrole aldehyde.

Cellular Elastic Cushion. No. 2,835,313. Howard M. Dodge, Marion, Ind. (to General Tire & Rubber Co., Akron, O.).

The mattress or cushion comprises horizontal top and bottom, the top being made of cellular elastic material and a series of parallel spacers of polyurethane between the top and bottom.

Reinforced Plastic. No 2,836,529. Harold H. Morris, Chicago, Ill.

The reinforced plastic product is embedded with parallelly-aligned, reinforcing, interwoven metal wires and glass fibers—the latter having lower coefficients of expansion than the wires. A thermosetting resin completely surrounds the fibers and wires, contracting at its heat of polymerization to hold the wires under stress.

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Volume I
Number 1

February-March 1959

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Moisture permeability of polymers I—crystallinity and orientation.

The dynamic mechanical properties of "hypalon"-20 synthetic rubber at small strains.

The dynamical properties of the new rubber-like irradiated polythene.

The deformation of foamed elastic materials.

The force-temperature behavior of swollen cellulose model filaments.

Mastication of rubber VII. Mechanical degradation of polymers during mastication.

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The aging of thiuram disulphide vulcanizates and their mechanism of vulcanization.

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Methyl ethyl ketone	lb.	.125	/ .165
Secondary butyl acetate	lb.	.1225	/ .1625
Alcohol	lb.	.125	/ .165

CALENDAR of COMING EVENTS

Jan. 27-30
SPE 15th ANTEC. Hotel Commodore, New York, N.Y.

Feb. 3-5
SPI 14th Reinforced Plastics Division Conference. Edgewater Beach Hotel, Chicago, Ill.

March 4
SPE Western New England Section. End User's Night. Bradley Field, Terrace Dining Room, Windsor Locks, Conn.

March 10
SPE Baltimore-Washington Section. Plastics in Packaging. Rolling Inn, Baltimore, Md.

March 17-19
Exhibit and 15th Annual Conference of National Association of Corrosion Engineers. Sherman Hotel, Chicago, Ill.

March 26-27
SPI 16 Pacific Coast Section Conference. Hotel Del Coronado, Calif.

April 20-21
SPI 17th Annual Canadian Section Conference. Windsor Hotel, Montreal, Can.

April 29-30
Manufacturing Chemists' Association, Inc. Packaging and Transportation of Chemical Products. Engineering and Scientific Center, Cleveland, O.

May 7
SPE Pittsburgh Section RETEC. Plastics and the Metals Industry. Penn-Sheraton Hotel, Pittsburgh, Pa.

In Brief . . .

Union Carbide Plastics Co. (formerly, Bakelite) has moved its Rochester, N. Y. sales office from 130 Main St. East to 3700 East Ave.

Celanese Corp. of America will double the capacity of its acetic acid plant at Pampa, Tex. Completion of new facilities is expected by late 1959. Biggest use for the material is the production of cellulose acetate, though much of the material is used for vinyl acetate, acetic anhydride, acrylate esters, and trimethylolpropane. The latter material is used in the production of polyurethane.

Domestic Production and Sales of Plastics and Resin Material, August and September, 1958

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of August and September, 1958. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

With respect to last month's figures, a continued increase is reflected in production and sales volumes of all materials except coumarones. Compared with this same period in 1957, cellulosics, ureas and melamines, vinyls, and polyesters are higher, phenolics remain about the same, while coumarones are down. Grand totals are averaging about 11% higher than in 1957.

	August, 1958		September, 1958	
	Production	Sales	Production	Sales
Cellulose Plastics:[1]				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,346,076	1,215,154	1,295,395	1,428,001
Sheets, 0.003 gage and over	1,400,451	1,450,256	1,715,861	1,820,271
All other sheets, rods, and tubes (including other cellulose plastics)	802,701	691,895	936,064	771,295
Molding and extrusion materials (including other cellulose plastics)	8,733,539	8,095,049	8,215,166	8,066,521
Nitrocellulose sheets, rods, and tubes	228,721	231,927	222,927	206,354
TOTAL	12,511,488	11,684,281	12,684,281	12,292,442
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	11,129,134	13,835,815	15,341,168	15,387,931
Bonding and adhesive resins for—				
Laminating (except plywood)	6,006,452	4,260,058	6,615,326	4,637,884
Coated and bonded abrasives	978,065	1,055,724	1,060,849	990,950
Friction materials (brake linings, clutch facings, and similar materials)[2]	941,898	1,203,442	1,337,477	1,320,739
Thermal insulation (fiber glass, rock wool)	4,236,238	4,399,773	4,375,947	4,327,396
Plywood	4,955,546	4,165,776	5,041,439	4,401,370
All other bonding and adhesive uses	3,312,021	3,221,722	3,161,788	3,307,204
Protective-coating resins unmodified and modified except by rosin	2,867,762	2,143,447	2,557,256	2,207,427
Resins for all other uses	2,710,625	2,287,375	2,965,743	2,584,126
TOTAL	37,137,741	36,573,132	42,456,993	39,165,027
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	2,704,753	3,122,477	2,981,417	2,846,488
Paper-treating and paper-coating resins	2,687,040	2,402,166	2,349,353	2,220,682
Bonding and adhesive resins for—				
Laminating	2,692,041	2,476,674	3,461,175	2,835,372
Plywood	8,844,612	8,566,285	10,404,249	9,917,990
All other bonding and adhesive uses	1,188,313	1,081,205	894,240	947,705
Protective-coating resins, straight and modified	2,420,264	2,341,820	3,196,907	2,657,850
Resins for all other uses, including molding	7,011,345	7,111,470	8,211,910	7,796,310
TOTAL	27,051,368	27,102,097	31,499,251	29,222,397
Styrene Resins:				
Molding materials[1]	33,946,142	34,378,893	40,361,199	41,122,376
Protective-coating resins, straight and modified	7,241,998	7,288,651	8,289,579	8,033,818
Resins for all other uses	13,253,173	10,640,708	14,895,900	12,051,772
TOTAL	54,441,313	52,308,252	63,546,678	61,207,966
Vinyl and Vinyl Chloride Resins:[3]				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		6,594,435		6,696,335
Sheeting (resin content)		5,546,777		6,688,370
Molding and extrusion (resin content)		19,285,642		20,312,577
Textile and paper treating and coating (resin content)[4]		6,244,746		6,193,596
Flooring (resin content)		10,529,600		10,339,630
Protective coating (resin content)		2,809,739		2,369,749
All other uses (resin content)		6,789,107		7,235,936
All other vinyl resins for—				
Adhesives (resin content)		4,361,736		4,308,407
All other uses (resin content)		9,496,894		11,348,841
TOTAL	69,671,931	71,658,676	82,133,434	75,493,441
Coumarone-Indene and Petroleum Polymer Resins	22,545,472	23,180,211	20,492,188	20,225,594
Polyester Resins:				
For reinforced plastics	6,905,237	6,778,205	7,336,557	7,143,861
For all other uses	1,085,707	1,075,687	1,393,852	1,422,215
TOTAL	7,990,944	7,853,892	8,730,409	8,566,076
Polyethylene Resins:				
For film		23,352,182		25,421,412
For all other uses		46,693,767		59,736,295
TOTAL	68,064,212	70,045,949	75,252,302	85,157,707
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding Materials[1, 6]	4,123,074	4,246,058	4,229,010	4,560,819
Protective-coating resins[5]	1,844,953	742,766	2,117,111	705,041
Resins for all other uses[6]	11,696,656	10,789,385	11,587,173	10,959,125
TOTAL	17,664,683	15,778,209	17,823,294	10,224,985
GRAND TOTALS	317,079,152	316,184,699	354,319,960	347,555,635

[1] Includes fillers, plasticizers, and extenders.
[2] Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3] Includes data for spreader and calendering-type resins.
[4] Includes data for acrylic, nylon, silicone, and other molding materials.
[5] Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins.
[6] Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
[7] Included with "All other bonding and adhesives uses."
SOURCE: United States Tariff Commission, Chemical Division.

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